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ABSTRACT

National compensatory education and the relationship between student achievement growth and educational processes are assessed in a first year report of the Sustaining Effects Study required by Title I of the Elementary and Secondary Education Act of 1965. Federal funds were authorized to provide special compensatory services to educationally deprived students. Study data include achievement scores; attitude measures; aspects of instructional service; and educational programs. Analyses approaches are varied. Part One discusses the effects of compensatory education in educational development and achievement. Instructional effects are analyzed and a structural-relation model is discussed. In Part Two the relationship between the educational process and development is presented in terms of data and analysis strategy. Basic skills achievement is considered with the influence of environment and instructional staff and practices. The characteristics of effective educational processes and students are discussed. Chapter summaries and conclusions, a bibliography, appendices of support material, and supplementary tables are included. (CM)

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REPORT 10:
COMPENSATORY SERVICES AND EDUCATIONAL DEVELOPMENT IN THE SCHOOL YEAR

Ming-mei Wang
Moraye B. Bear
Jonathan E. Conklin
Ralph Hoepfner

TM 820 275

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STUDY OF THE SUSTAINING EFFECTS OF COMPENSATORY
EDUCATION ON BASIC SKILLS

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1. Heopfner, Ralph; Zagorski, Henry; and Wellisch, Jean. The Sample for the Sustaining Effects Study and Projections of its Characteristics to the National Population. System Development Corporation, Santa Monica, California, June 1977.

2. Breglio, Vincent J.; Hinckley, Ronald H.; and Beal, Richard S. Students' Economic and Educational Status and Selection for Compensatory Education. Decima Research, Santa Ana, California, January 1978.

3. Hinckley, Ronald H.; Beal, Richard S.; and Breglio, Vincent J. Student Economic and Educational Status and Receipt of Educational Services. Decima Research, Santa Ana, California, June 1978.

4. Hinckley, Ronald H. (Editor); Beal, Richard S.; Breglio, Vincent J.; Haertel, Edward H.; and Wiley, David E. Student Home Environment, Educational Achievement and Compensatory Education. Decima Research, Santa Ana, California, January 1979.

5. Wang, Ming-mei; Hoepfner, Ralph; Zagorski, Henry; Hemenway, Judith A.; Brown, Deborah S.; and Bear, Moraye B. The Nature and Recipients of Compensatory Education. System Development Corporation, Santa Monica, California, September 1978.

6. Haggart, Sue A.; Klibanoff, Leonard S.; Sumner, Gerald C.; and Williams, Richards S. Resource Analysis of Compensatory Education. RMC Research Corporation, Santa Monica, California, October 1978.

7. Sumner, Gerald C.; Klibanoff, Leonard S.; and Haggart, Sue A. An Analysis of the Cost and Effectiveness of Compensatory Education. RMC Research Corporation, Santa Monica, California, August 1979.

8. Klibanoff, Leonard S.; and Haggart, Sue A. Summer Growth and the Effectiveness of Summer School. RMC Research Corporation, Santa Monica, California, June 1980.

9. Hemenway, Judith A.; Wang, Ming-mei; Kenoyer, Charles E.; Hoepfner, Ralph; Bear, Moraye B.; and Smith, Gerrie. The Measures and Variables in the Sustaining Effects Study. System Development Corporation, Santa Monica, California, December 1978.

9A. The SES Staff. A Compilation of the Instruments Used in the Sustaining Effects Study. System Development Corporation, Santa Monica, California, April 1979.

10. Wang, Ming-mei; Bear, Moraye B.; Conklin, Jonathan E.; and Hoepfner, Ralph. Compensatory Services and Educational Development in the School Year. System Development Corporation, Santa Monica, California, November 1981.

11. Kenoyer, Charles E.; Cooper, Deborah M.; Saxton, D. Eugene; and Hoepfner, Ralph. The Effects of Discontinuing Compensatory-Education Services. System Development Corporation, Santa Monica, California, February 1981.

12. Zagorski, Henry; Conklin, Jonathan E.; Cooper, Deborah M.; Hoepfner, Ralph; and Wang, Ming-mei. Does Compensatory Education Narrow the Achievement Gap? System Development Corporation, Santa Monica, California, December 1981.

13. Hoepfner, Ralph (Editor). Substudies on Allocation and Targeting of Funds and Services, Assessment of Student Growth, and Effects of Attrition. System Development Corporation, Santa Monica, California, May 1981.

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A GENERAL INTRODUCTION TO THE SUSTAINING EFFECTS STUDY AND AN OVERVIEW OF THE PRESENT REPORT

DESCRIPTION OF THE STUDY

In response to questions about educational policies, SDC is studying compensatory education (CE) — its nature, quantity, and sustained effects — in a large study called The Sustaining Effects Study. This study will result in a series of reports from the following substudies:

The Longitudinal Study. In the Longitudinal Study, the growth of children in reading, math, functional literacy, and attitudes toward school were assessed in the fall and spring for three consecutive years. The amount and kind of instruction in reading and math was also determined for each student. In addition, teachers and principals report on their practices of instruction and teaching. Thus, it was possible not only to assess student growth over a three-year period, but to relate this growth to aspects of instruction.

The schools in the study were drawn from three different groups. The REPRESENTATIVE SAMPLE of schools is a sample carefully drawn to represent all of the nation's public schools that have some of the grades one-through-six. A second group of schools, the COMPARISON SAMPLE, is composed of schools that have large proportions of students from poor homes but do not receive special funds to offer CE services. The third group is the NOMINATED SAMPLE, composed of schools nominated because their educational programs had promise of being effective for low-achieving students. During the first year of the study, data were collected from 328 schools and about 118,000 students.

The Cost/Effectiveness Study. Information was obtained on the resources and services to which each student was exposed during reading and math instruction. Cost estimates were generated on the basis of this information. Because the effectiveness of the instructional programs is being determined in the Longitudinal Study, it is possible to relate the effectiveness to the cost of each program.

The Participation Study. The purpose of the Participation Study was to determine the relationships among economic status, educational need, and instructional services received. The educational achievement of the students and the services they received were obtained in the Longitudinal Study, and the refined measures of economic status were obtained in the Participation Study. Visits were made to the homes of over 15,000 randomly selected students from the schools in the first-year REPRESENTATIVE SAMPLE. During the visits, information was collected on the economic level of the home and on the parents' attitudes toward their children's school and learning experiences. Thus, the level of student achievement and services could be related to the economic level of a student's home.

The Summer Study. The Sustaining Effects Study also examined the effectiveness and cost-effectiveness of summer-school programs. Information about the summer school experiences of the students was combined with other data. The resource-cost model, developed for the regular-year, cost-effectiveness study, was adapted to the needs of the summer-school study.

Successful Practices in High-Poverty Schools. This study identifies and describes instructional practices and contexts that are effective in raising the reading and math achievements of educationally disadvantaged students. In-depth observational and interview data were collected from 55 schools that participated in the study.

THE REPORT SERIES

The major findings of the reports already published are discussed briefly below, along with references to the specific reports from the study that address them.

A Description of the Samples for the Sustaining Effects Study and the Nation's Elementary Schools. In order to understand the findings of this study, it is essential to become familiar with the characteristics of the samples used and their capabilities of providing generalizations to the population of the nation's schools. Technical Report 1 (Hoepfner, Zagorski, and Wellisch, 1977) describes in detail the samples and how they were formed. It also presents the results of a survey of 4,750 public schools with grades in the 1-6 range by projecting the data to the nation. These projections accurately describe the nation's elementary schools in terms of their characteristics, the kinds of services they provide to students, and the characteristics of the students. The interrelationships among these characteristics are also addressed.

Some characteristics of the nation's public schools are summarized below:

- *Enrollment, Urbanism, and Achievement.* The total grade 1-6 enrollment in the 1975-76 school year was estimated at about 21 million students. There is a moderately strong relationship between enrollment and urbanism, with large cities having larger schools than rural areas. In general, schools in large cities have lower achievement levels than those in rural areas.

- *Compensatory-Education Funds, School Characteristics, and Achievement.* About two-thirds of the nation's elementary schools received Title I funds, and about one-fifth received no compensatory funds from any sources. There is little relationship between receipt of compensatory funds and the size of a school. However, small-city and rural schools tend to receive such funds more frequently than do large-city schools. As expected, schools with high concentration of poor students tend to receive compensatory funds more often than do schools with low concentration. Similarly, schools with higher percentages of low-achieving students are more likely to receive compensatory funds.

- *Achievement and Concentrations of Poor and Minority Students.* There is a strong association between percentage of low-achieving students and concentrations of poor and minority students.

- *School's Grade Span.* Generally, the grade span in the school has small relationships with the size of school, degree of urbanism, and concentrations of low-achieving, poor, and minority students.

- *Stability of Student Body.* Schools tend to have less stability in their student bodies as the size of the school increased, and there tends to be less stability in large cities. Similarly, stability decreases as concentrations of poor, minority, and low-achieving students increase.

- *Availability of Summer Schools.* Fifty-one percent of the nation's schools with grades 1-6 have summer-school programs available for their students. Larger schools provide summer-school programs more frequently than do smaller schools. There is practically no relation between the availability of summer school and a school's level of poverty, minority concentration, or level of achievement of the students.

A Description of Student Selection for Compensatory Services as It Relates to Economic Status and Academic Achievement. The Education Amendments of 1974 require several studies to inform

Congress who does and who does not receive Title I services and how selection for such services is related to economic status of the family and the academic performance of the child. In addition, the federal program administrators wanted to know the differences between the services received by economically and educationally deprived children and those by non-deprived children, and the relationships between academic achievement and the children's home environment. These questions were addressed in Technical Reports 2 (Breglio, Hinckley, and Beal, 1978), 3 (Hinckley, Beal, and Breglio, 1978), and 4 (Hinckley, Beal, Breglio, Haertel, and Wiley, 1979). A brief summary of answers to the questions is provided below:

- About 29 percent of poor students participate in Title I compared to about 11 percent of the non-poor students (Report 2). Looking at CE in general, about 40 percent of the poor students and about 21 percent of the non-poor students participate. From these findings, we can see that proportionally more poor students participate in the services than non-poor ones.

- Using the grade-equivalent metric as the definition for educational disadvantage (one year below expectation for the student's current grade), about 31 percent of the low-achieving students participate in Title I, while only 10 percent of the regular-achieving students do (Report 2). For CE in general, the percentages are 46 for low achievers and 19 for regular achievers. Among the regular achievers who participate in CE, many score below the national median on achievement tests.

- Participation rates for Title I and for CE in general are the highest for students who are both economically and educationally disadvantaged (Report 2). Forty-one percent of these students participate in Title I, and 54 percent participate in CE in general. Participation rates are next highest for students who are educationally but not economically needy (26 and 41 percent, respectively), and next highest for students economically but not educationally needy (20 and 28 percent, respectively). Only 7 percent of the students who are neither educationally nor economically needy participate in Title I (15 percent for CE in general). These participation rates were interpreted as indicating that the then-current allocation procedures were being complied with and that the intentions of the law were being met fairly.

- In comparison to non-poor students, poor students receive more hours of instruction per year with *special* teachers, more hours of instruction in medium- and small-sized groups, fewer hours of independent study, more non-academic services such as guidance, counseling, health and nutrition (Report 3). The differences are even stronger when poor Title I students are compared to others. Therefore, we can conclude that the distribution of educational services is in line with the intent of the laws and regulations.

- Two aspects of the children's home environments bore significant and consistent relations to achievement: amount of reading done at home and the educational attainment of the head of household. Other variables, such as family size, TV-watching behavior, and type of living quarters were not consistently related to student achievement (Report 4). Although most parents (67 percent) know whether their children's schools have special programs for low-achieving students, few (40 percent) know of Title I and even fewer know of or participate in local governance of the Title I program. Poor parents, in general, are less involved in their children's educational programs, have lower expectations of their children's attainments, give lower ratings to the quality of their children's educations, but perceive Title I and other CE programs as being helpful.

Description of the Nature of CE Programs, Characteristics of Participating Students, Schools, and Educational Services. The Participation Study deals almost exclusively with what has been called 'selection for CE or Title I services,' without examining too closely what such programs really are and how they differ from the programs regularly offered by the schools. Before we could draw any relationships between participation in a CE program and the educational progress of students, we had to be assured that there really was a program that was distinct, could be specified in some way, and had a reasonable chance of making an impact. As will be seen, not only did we analyze data on the basis of program participation, but we also considered the actual services received in order to address directly the possible differences between the intention and the actuality.

Based on the analyses of data obtained from about 81,500 students in the Representative Sample of schools, Technical Report 5 (Wang, Hoepfner, Zagorski, Hemenway, Brown, and Bear, 1978) provides the following important conclusions:

- Students participating in CE are lower achievers (mean score at the 32nd percentile) than non-participants (53rd percentile). Seventy percent of the participants were judged by their teachers as needing CE, while only 19 percent of those not participating were so judged. More minority students participate in CE, proportionately, than white students, but participation in CE has little relationship with student attitudes to school, early school experience, summer experiences, or the involvement of their parents in their educational programs.

- Minority, poor, and low-achieving students tend to receive more hours of instruction in smaller groups and by special teachers, and receive more non-academic services, but their attendance rates are generally lower too, so they do not take maximum advantage of the special services provided.

- The useful predictors of whether or not a student is selected to receive CE are his/her teacher's judgment of need and participation in CE in the previous year. When these variables are considered, achievement scores, non-English language spoken in the home, and economic status contribute little more to the prediction.

- About two-thirds of the students participating in CE in 1975-76 participated in the 1976-77 school year also.

- CE students in general and Title I students in particular receive more total hours of instruction per year than non-CE students. The CE students also receive more hours of instruction from special teachers. Among CE students, Title I students receive the greatest number of hours of instruction, more frequently with special teachers, and in small instructional groups. There are no significant and consistent differences between CE students and non-CE students with regard to their teacher's instructional subgrouping practices, use of lesson plans, extent of individualization of instruction, frequency of feedback, or assignment of homework.

- Students receive between five and nine hours of reading instruction per week, decreasing steadily with higher grades, and between five and six hours of math instruction per week, fairly constant over all grades.

- CE services are delivered during regular instructional hours with different kinds of activities for the participants (so that, in effect, they 'miss' some regular instruction received by their non-participating peers).

- Title I schools have higher average per-participant CE expenditures in reading and math than do schools with other CE programs. The average Title I per-participant expenditure is about 35 percent of the average per-pupil regular (base) expenditure.

- Schools receiving CE generally have higher concentrations of poor students and low-achieving students, and students with less educated parents. These schools have greater administrative and instructional control by their districts and have higher staff-to-student ratios.

- Schools that select higher percentages of regular-achieving students for CE services have larger percentages of minority and poor students, probably reflecting their tendency for saturation of CE programs.

- Most districts use counts of students receiving reduced-price lunches and counts of aid to families with dependent children to determine school eligibility for compensatory funds, while most schools select students on the basis of standardized achievement tests, frequently augmented by teacher judgments. Similar selection criteria are employed by non-public schools.

Cost Effectiveness of Compensatory Education. In its deliberations for the reauthorization of Title I and in annual appropriation hearings, members of Congress also wanted information on the effectiveness of the Title I program relative to its cost. While it appears eminently sensible to ask the question of cost-effectiveness, it is difficult to provide the answers in a manner that will be interpreted correctly.

In the study of cost-effectiveness of CE, efforts were made to preclude enigmatic conclusions and, at the same time, to make cost estimates on a sounder basis than in the past. In Technical Report 6, Haggart, Klibanoff, Sumner, and Williams (1978) develop and present a resource-cost model that translates educational resources for each student into estimates of average or standard dollar cost for his/her instructional program. The overall strategy for estimating cost is to provide an index that represents the labor intensity of services without being confounded with regional price differentials or different accounting methods.

Using the resource-costs, CE students in general, and Title I students in particular, were found to be offered substantially higher levels of educational resources, and hence, more costly programs. Participation in CE differentiates the resource-costs for services offered much more than do poverty, achievement level, race, or any other characteristics.

In Technical Report 7, Sumner, Klibanoff, and Haggart (1979) related resource-costs to achievement to arrive at an index of cost-effectiveness. Because of the low achievement levels of the children participating in CE and their relatively slow rates of achievement growth, the increased cost associated with CE appeared to be misspent (in the same way that money for severely ill and terminal patients appears to be not as effectively spent as it is for mildly ill patients). It is important to point out, however, that the appearance may not tell the true story. Because we cannot obtain truly appropriate comparison groups, we do not know what would have happened to the achievement growth of the CE students if they had not participated. Based on the comparison groups we could form, however, CE programs did not appear to have an advantage over regular programs in terms of cost-effectiveness.

The Effectiveness of Summer-School Programs. The study has also examined the results of attendance at summer school, because members of Congress and program administrators want to know if such attendance helps prevent the presumed progressive academic deficit of low-achieving students. If attendance at summer school has positive academic effects insofar as the attendees will not 'fall back' to their achievement levels of previous years, then summer programs can be considered as a means of sustaining the school-year growth.

Technical Report 8 (Klibanoff and Haggart, 1980) shows that attendance at summer school has little or no effect on the academic growth of the students who attend, especially the low-achieving students. Because the findings are based on the study of summer schools as they presently exist (and the evidence is strong that they do not offer intensive academic experiences), the non-positive findings should not be interpreted as an indictment of summer school, as such, but an evaluation of the way they are presently organized and funded. Nevertheless, when instructional services delivered in summer schools were investigated, none seemed particularly effective in improving students' achievement growth.

In the same report, the authors also addressed the hypothesis of 'summer drop-off,' a hypothesis advanced to explain the presumed widening achievement gap between regular and CE students. Essentially, this hypothesis states that CE students lose much more of their previous year's learning during the summer recess than do regular students. Data collected in the study fail to support the summer drop-off hypothesis: CE students do not suffer an absolute 'drop-off' (although their achievement growth over the summer is less than that for regular students, as in the school year). In any event, attendance at summer school does not have much of an effect.

(Technical Report 9 is a resource book. It identifies all the variables and composites that have been selected or devised for use in the Sustaining Effects Study. All measures and scales are described and rationalized. In addition, Report 9A serves as a companion volume that contains copies of all the data-collection instruments in the study except for a few that are constrained by copyright.)

The Effects of Compensatory Education and Educational Development of Students. The present report (Technical Report 10) addresses the effects of compensatory services on student's development during the school period. It also examines the instructional services and major dimensions of the educational process to describe the characteristics of programs that are effective in raising achievement level. The analysis is based on the first-year data of the study. Similar investigations will continue in subsequent reports.

Studies Still to be Done. The remaining reports, yet to be issued from the study, will address the general effects of educational practices on raising students' achievement levels, with special attention paid to the practices found in CE programs in general and in Title I programs in particular. Impact analyses will either be based on three-year longitudinal data or will be based on in-depth observations and interviews. The extensive achievement data collected from overlapping cohorts of students in the three years will be utilized to describe the patterns of educational growth over the years for various groups of CE and non-CE students. Analyses of the three-year longitudinal data will allow us to examine the sustained effects of CE and help us determine if the presumed phenonenon of gap-widening between the disadvantaged and non-disadvantaged students indeed exists.

OVERVIEW

This report presents the first-year findings of the Sustaining Effects Study. The objectives are to examine the effects of compensatory services on the educational progress of students during the school period and determine the educational dimensions that promote achievement growth. The report is based on data from the first year of the study which include a nationally representative sample of schools. It examines the patterns of students' achievement in reading, math, and practical skills and compares them between students who do not receive compensatory services in order to assess the effects of such services. It also investigates the relationships between achievement growth and major aspects of the educational process (e.g., instructional services, instructional personnel, policies and practices, and school environment).

The central finding of this report is that, during the school year, compensatory services have positive impacts on reading achievement primarily at the first three grades and, later, at grade 6, and on math achievement at all grades. The ways in which the observed effects come about, however, are not clear; and the beneficial effects of compensatory programs, while detectable, are not large. Whether the effects are worth the costs involved awaits social and political judgments; whether the effects will be sustained over the years awaits analyses in the future reports of this study.

This central finding is derived from Part I of the report, concerning *the effects of Compensatory Education and Instructional Services.* The key findings from Part II, on *the Relationships Between the Educational Process and Educational Development,* are:

- The amounts of regular instruction and tutor/independent work have some positive, but modest, effects on achievement growth. On the other hand, amount of instruction by special teachers, aides, and assistants, or in small groups (less than seven students) does not often have detectable effects; and when it does, the effect is negative.

- Students taught by more experienced teachers tend to obtain greater growth in both reading and math achievement. This finding is generally consistent across the six elementary grades.

- With regard to existing conditions of the school, students in schools having higher concentrations of compensatory-education students, although they tend to be low achieving, achieve slightly greater growth than their comparable peers in schools having lower concentrations. This result is obtained for both reading and math, particularly at the first two grades. At the same time, a higher concentration of low achievers in the school is frequently less conducive to achievement growth. As these two conditions tend to coexist in the same schools, the compensatory effort would merely help alleviate the disadvantage of the students in these schools.

- Temporary disturbance of instruction caused by physical fights or violence tends to hamper reading and math achievement at the upper three grades, but not at the earlier grades.

- More frequent feedback to students regarding their academic progress sometimes helps them achieve greater growth in reading and math.

- At some grades, the more time teachers devote to planning and evaluation of the programs, the greater their students grow in reading achievement.

- There are few interaction effects on achievement between student characteristics and educational process. Where there are significant interactions, the differential effects of the educational dimensions rarely reveal a systematic and meaningful pattern over the grades; and the association between the effects and student characteristics is weak.

The report addresses seven specific questions. The first four are discussed in Part I; the second three in Part II.

1. *During the school year, do compensatory-education students demonstrate greater educational development than expected of them without compensatory services?*

   In general, there are positive effects of compensatory services on the achievement growth of students in both reading and math — compensatory-education students achieve appreciably larger gains than the expectations. However, the magnitude of the effect is dependent on the comparison standards and analytical approaches. The supportive evidence of positive impacts is less clear in reading than in math. In reading, positive but small effects are demonstrable at the first three grades and, later, at grade 6. In math, such impacts are shown at all elementary grades, although to different degrees. The positive effects are mostly observed in programs that are funded at least in part by Title I; there is little evidence of such effects in programs that are funded exclusively by non-Title I sources.

   There are seldom contradictory findings among different analytical methods based on varying assumptions. Compensatory programs, Title I in particular, are effective in accelerating student achievement growth during the school period. As a result, the programs are expected to help narrow the anticipated achievement gap between the participants and their non-disadvantaged peers.

   Partly because of the inadequacy of the measures, there are few noteworthy findings with respect to the effects of compensatory programs on practical achievement and attitudinal development.

2. *Within a school year, do the instructional services delivered to compensatory-education students result in reduction of the anticipated achievement gap between them and regular students?*

   The previous question referred simply to the effects of compensatory programs; this one asks about the role of instructional services. The direct answer is that there is no striking evidence that amount of instructional services is the primary factor affecting achievement growth. There are generally positive relationships between achievement growth and total instructional time, but the relationships are weak.

In samples consisting of students who receive compensatory services and those who do not receive the services but are judged to have need for them, the multiple-regression analyses conclude that amounts of instruction in three settings (regular, special, and tutor/independent) jointly contribute very little to the explanation of the achievement variations at the posttest, relative to the contribution of pretest achievement and background factors. The table below gives the range of the contributions in the six grades.

Proportions of Variance of Posttest Scores Accounted For

Variance Component	Reading	Math
Unique to pretest score and student background	.31 — .57	.27 — .49
Unique to amount of instruction received	.00 — .01	.00 — .01
Unique to CE-selection status	.00 — .00	.00 — .01
Shared by two or more of the three sets of variables	.04 — .07	.02 — .07
(Variance unaccounted for)	.34 — .64	.47 — .65

Note that in this table, categories of compensatory programs also account for a very small proportion of the posttest variations. This may appear to refute the positive effects of compensatory services indicated in question 1 above. For two reasons, it does not, however: *first,* with samples as large as those in this study, statistical significance can be consistent with small explanatory power; *second,* participation in compensatory programs can affect achievement by ways of its relationship with other variables (for example, see the fourth row of the table).

Further examination of the roles of different kinds of instruction reveals that amounts of regular instruction and independent work have positive effects on achievement, while amount of special instruction that characterizes the services received by compensatory-education students rarely shows an appreciable effect. In light of this finding, it is concluded that the positive effects of compensatory programs cannot be attributed to the amount of special services provided to the students.

3. *What is the critical level of effort for reducing this anticipated achievement gap?*

There is not enough evidence to support the concept of a 'critical level' of effort above which compensatory-education students will achieve larger gains than normally expected of them to result in a narrowing of the anticipated achievement gap between them and regular students. The data from this study frequently do not confirm the expectation that achievement growth increases with level of instructional effort (which is measured by the resource-cost of the services). Lacking clear evidence of such a trend, it is not possible to determine the level of effort that will ensure an improvement of the relative achievement standings of compensatory-education students.

Supplemental analyses reveal that only in a few cases, achievement growth increases consistently as the level of effort is raised, but this trend is generally weak. In most cases, the data show a slight trend of larger gains for greater efforts up to a certain level; and then as the effort-level continues to rise, this trend reverses itself. It is suggested that the chances of finding a critical level of effort, if it exists, may be improved by refining the measures of achievement growth and instructional effort.

4. *Does compensatory education have greater effects on the participants' achievement growth at some grades than at others? Are the effects different for students who did and did not participate a year earlier? And, does this pattern of differences vary with the amount of services received?*

The cross-sectional analysis shows that, under current implementation, compensatory services benefit the participants more at the earlier grades, particularly the first grade. Such greater effects are not accompanied by greater effort of the programs. It is concluded that earlier compensatory services are more efficient in helping the participants improve their achievement.

The beneficial effects of compensatory services are evident mostly in programs that receive at least partial support from Title I funds. The relative effects of Title I services at the six grades can be seen by comparing the average percentile changes from pretest to posttest between Title I students and a standard group of students. The standard group comprises students who are judged to have need for compensatory services, but do not receive such services because their schools do not have compensatory programs. The pretest and posttest percentile scores for these two groups are plotted in the following figure by grades to illustrate the larger gains of Title I students (relative to the standard group) at the earlier grades.

The effects of Title I services on reading achievement are particularly noticeable at the first three grades, where the average percentile rank of Title I students rises at the posttest, while that of the standard group falls. By comparison, the effects of Title I services on math achievement are not strikingly different among grades, although the effects remain more substantial at the earlier grades.

With regard to how participation history influences the immediate effects of compensatory services provided in subsequent years, comparisons of the achievement growth between current compensatory-education students who did and did not receive the services in a previous year reveals mixed results. There is some evidence showing that the immediate effects of compensatory services are enhanced by previous participation in the programs. However, there is also evidence indicating the opposite — the effects of current services are smaller for participants who repeat the programs than for those who are 'new' to the programs. In many other cases, the data suggest that the effects of compensatory services in a given year are not influenced by receipt of such services in an earlier year. In general, these findings are not substantially affected by the amount of instructional services.

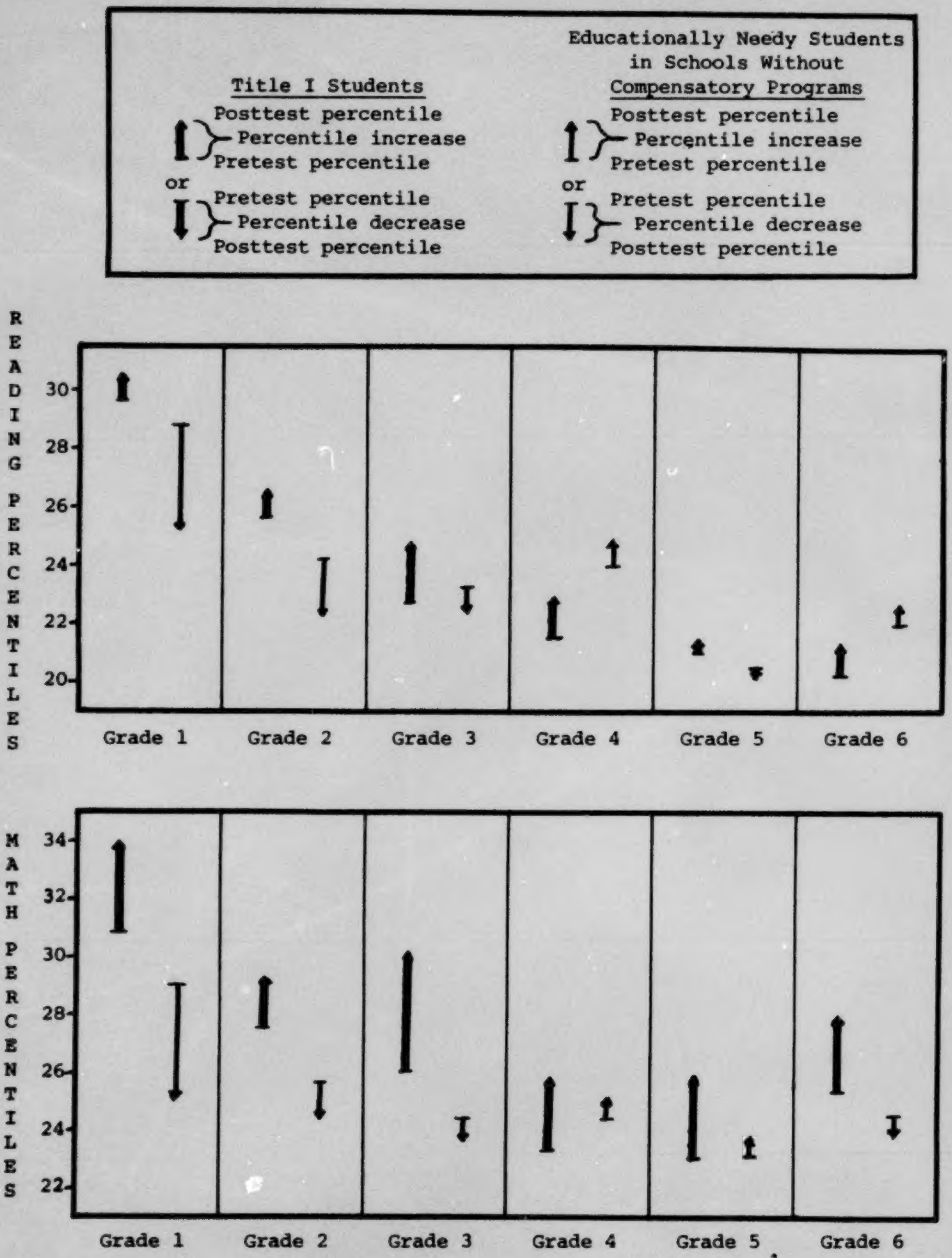
5. *How are instructional services, school environment, and educational methods related to student's educational development?*

Amounts of instruction, characteristics of instructional staff, school's environment, and teacher practices in the classroom together do not account for much of the variance of posttest scores. Analysis of the first-year data shows that the variations of posttest achievement among students are mostly attributable to their differences with respect to pretest achievement and family background. The unique contribution of the whole set of these educational variables is small, suggesting that the educational process does not play a prominent role in explaining achievement growth.

Concerning the relationships between achievement progress and specific dimensions of the educational process, the following findings are noteworthy:

- Among different kinds of instruction, amount of instruction by regular teachers in groups of seven or more students has positive effects on reading and math achievement, but such positive effects are not evident at all grades. This finding merely reconfirms the results explained in question 2 above.

- Largely because of the policy of providing the special services primarily to low-achieving students, it is difficult to detect any positive effects of the amount of instruction by special teaching staff or in small groups. Indeed, the relationship between amount of such special instruction and achievement growth sometimes remains negative after controlling for preexisting differences among the students.



Average Percentile Gains or Losses (from Pretest to Posttest) for Title I Students and Students Who Are Judged to Have Need for Compensatory Services but Do Not Receive the Services Because Their Schools Do Not Have Compensatory Programs

- Amount of independent seat-work or instruction by tutors occasionally demonstrates positive effects on achievement.

- Among other manipulable aspects of the educational process, only the teaching experience of the instructional staff consistently demonstrates a positive effect on achievement.

- All other educational variables that have consistent influences on achievement reflect school's existing conditions that are not subject to changes through simple manipulations. For instance, students in schools having higher concentration of low-achieving students tend to progress less during the school period.

6. *Are the characteristics of effective educational programs different by grade levels?*

Few of the obviously manipulable characteristics of educational process (e.g., teacher's practices) show consistent effectiveness in enhancing achievement at all grades. Moreover, there are few systematic and meaningful differences among grades with regard to the effect of various educational dimensions. As a summary, discriminant analysis of two groups of students having relatively high and low growth suggests a general picture of more effective programs:

- Students are taught by more experienced teachers.

- Students receive more regular instruction by classroom teachers in medium to large groups.

- Students spend more time working with tutors or on study materials independently.

- Students are more frequently provided with feedback concerning their progress.

- There are few disturbances of instruction caused by physical fights or violence.

7. *Are the effects of various educational dimensions associated with student characteristics?*

No clear picture emerges from the analysis concerning what educational methods are most effective for different kinds of students. In reading, the few significant interactions between the effects of educational programs and student characteristics vaguely suggest that the educational aspects emphasized by compensatory programs (such as parent/community involvement, inservice training for teachers) tend to be more beneficial to the achievement of students who are more likely to receive compensatory services (those who are poor and low achieving). While this abstracted finding is encouraging, there is not much confidence of its practical meaning as each result is obtained only in an isolated grade. In math, most of the interaction effects involve school conditions that are determining factors for receiving compensatory funds; the few other interactions that involve teacher's characteristics (e.g., teaching experience) are weak and not shown in more than one grade. It is concluded that considerations of interactions with student characteristics do not substantially further our understanding of the relationships between the educational process and achievement.

In addition, the discriminant analysis of two groups of compensatory-education students who are 'successful' (achieve better gains than expected) and 'unsuccessful' finds few specific characteristics of the programs that are particularly effective in improving the achievement of the deprived students but not that of other elementary students. It is suggested that further progress in this area of inquiry would require better data on home environment, teacher, and classroom behaviors.

CHAPTER 1. INTRODUCTION

This chapter is intended to prepare the reader for a proper perspective of this report. We review briefly the history of compensatory education, especially of Title I of the Elementary and Secondary Education Act of 1965, leading to the Sustaining Effects Study. The sample and the data that constitute the basis for this report are explained. The sample includes 328 schools; 242 of them constitute a nationally representative sample. The data come from the first year of the study and consist of achievement scores, attitude measures, and information on student backgrounds, instructional services, and educational programs. The purpose of this report is to assess the effects of compensatory services and examine the relationships between achievement growth and the educational dimensions. The data are analyzed with multiple approaches in order to present a comprehensive picture of the current state of compensatory-education programs.

The problem of data attrition, being a common concern in all analyses for this report, is addressed in this chapter. As achievement scores are some of the most critical data for this report, we focus the discussion on the rates of missing test scores and how they are related to student backgrounds. We also compare the achievement levels between students for whom we have both pretest and posttest scores and those for whom we have only one or the other. Overall, 9.4 percent of the students in the first-year sample have only pretest scores while 8.4 percent have posttest scores only. This leaves about 82 percent of students who have both pretest and posttest scores. By race/ethnicity, students of Spanish heritage have the highest rates of missing scores while non-Hispanic whites have the lowest. With respect to economic status, students from low-income families have greater rates of missing scores than others. On the whole, there is a consistent tendency for those who are absent in one testing to achieve slightly lower than those who are present in both testings.

In light of the pattern of missing data among students of different characteristics and the achievement differences between students with and without missing scores, there is a concern that the results of the analyses based on cases with complete data may be, to some extent, biased. However, because the missing-data rates are moderate and because student characteristics have been used to control for preexisting differences in assessing growth, we expect the loss of information because of missing data to have little influence on the validity of our findings.

In 1965, Congress passed the Elementary and Secondary Education Act (ESEA) that authorized federal funds to provide compensatory education (CE) to educationally disadvantaged students in schools with high concentrations of children from low-income families. The goal of Title I of ESEA is clearly stated in Section 101 of Public Law 89-10, 'Elementary and Secondary Education Act of 1965':

> *In recognition of the special educational needs of children of low-income families and the impact that concentrations of low-income families have on the ability of local educational agencies to support adequate educational programs, the Congress hereby declares it to be the policy of the United States to provide financial assistance (as set forth in the following parts of this title) to local educational agencies serving areas with concentrations of children from low-income families to expand and improve their educational programs by various means (including preschool programs) which contribute particularly to meeting the special educational needs of educationally deprived children.*

To ensure that Title I programs are effective in meeting this goal, the legislation specifically requires that the programs be evaluated regularly and the results reported to Congress. The Title I evaluation system, as envisaged by the Congress, was to collect data locally and aggregate them at the state level to form the States' Annual Evaluation Reports. The Office of Education (now the Department of

Education) received the state reports and attempted to aggregate their data in order to establish a basis for a national evaluation.

A desire to obtain further information beyond that in the state reports prompted the federal government to initiate independent evaluations of Title I. Earlier efforts included the TEMPO Study (General Electric Company-TEMPO, 1967, 1971), two national surveys during the 1967-69 school years (Glass, 1970), and an attempt to synthesize data from many diverse sources between 1965 and 1970 (Wargo, Tallmadge, Michaels, Lipe, and Morris, 1972). In general, these efforts found little evidence that the Title I program had an overall positive impact on achievement. However, it was pointed out that data from some state and local agencies showed evidence of positive impact.

In order to improve the quality of data for national evaluations, the Office of Education contracted with the Educational Testing Service in 1971 to conduct the Compensatory Reading Study (CRS). For the first time, standardized achievement tests were administered at approximately the same time to students from a large and nearly representative sample of schools. Although findings varied with the analytic methods employed, there were indications of positive effects within a single school year, particularly for students in the second grade. In cases where no positive achievement impact was demonstrated, the results also revealed no evidence that compensatory reading students were falling farther behind their non-CE peers in achievement (Trismen, Waller, and Wilder, 1975; USOE, 1976).

While the results of the Compensatory Reading Study were encouraging, it has not been able to provide a comprehensive picture of the effects of CE, as it involved only reading programs in grades 2, 4, and 6. Other evaluations also were aimed primarily at examining the effects of Title I programs on reading achievement, with little attention paid to achievement in math. This favoritism to the evaluation of compensatory reading programs is a reflection of the greater emphasis of CE programs on improving reading skills, as those skills are essential for learning other skills and for success in later life. But such one-sided emphasis leaves us with little information about the effect of CE on math achievement. Thus, there was a need to study math CE programs and to involve all six elementary grades on which Title I funds and efforts were concentrated.

The Education Amendments of 1974 (Public Law 93-380) added a new section to Title I to direct the U.S. Commissioner of Education to expand efforts to describe the actual and potential participants of Title I programs and to evaluate the effects of such participation. Prompted by this requirement and the interest in the long-term effects of Title I services, the U.S. Office of Education (now the Department of Education) planned a large-scale evaluation study of Title I but also concerning state and local compensatory-education programs. Through competitive procurement, System Development Corporation was then awarded a contract to conduct a five-year 'Sustaining Effects Study' (SES), beginning in July, 1975.

The Sustaining Effects Study collected data from both a nationally representative sample and purposively selected samples for three consecutive years (1976-1979). The data-collection effort included both reading and math programs, and covered the six elementary grades. The study has thus established a comprehensive data base that allows analyses required to answer many of the questions about the effects of CE and the effectiveness of different educational practices, as well as detailed descriptive analyses regarding the nature of the national CE effort and its participants.

Most evaluation studies of the Title I program conducted before 1976 were reviewed in detail by the staff of the American Institutes for Research under contracts with the National Institute of Education in 1977. Findings have been summarized by Rossi, McLaughlin, Campbell, and Everett (1977) and synthesized by McLaughlin (1977); while the controversial issues surrounding the evaluations of CE and various aspects of sampling and methodological problems are discussed in McLaughlin, Gilmartin, and Rossi (1977). Referring to these documents, the reader could quickly learn about the inadequacies of the data, the less-than-definitive findings, and many of the methodological problems that plague survey evaluations. In a table summarizing evidence concerning the general effectiveness of CE, McLaughlin (1977) pointed out that all studies were based on data of questionable validity, and lacked a representative sample, with the exception of the Compensatory

Reading Study. The Sustaining Effects Study was designed to overcome many of the difficulties in the earlier evaluations and, at the same time, to allow information to be extracted to aid us in understanding some of the current controversial issues.

For instance, one of the controversies about the long-term effectiveness of CE has been that, despite evidence showing improvements for the CE students during the school year, they appear to fall farther and farther behind their non-disadvantaged peers as they progress to higher grades. Many explanations have been offered for these paradoxical findings. Some attribute the falling-behind to losses over the summer (Thomas and Pelavin, 1976; Pelavin and David, 1977). Some blame it on discontinuation of compensatory services just as the students begin to benefit from them (and become no longer qualified to receive them according to strict interpretations of guidelines, U.S. General Accounting Office, 1975). However, these explanations were usually generated from flawed analyses. Thus, it is important that the longitudinal data of the Sustaining Effects Study are used to furnish information that may lead to resolution of such controversies. Table 1-1 provides a list of shortcomings of previous evaluation studies and briefly describes how the design of the Sustaining Effects Study attempted to overcome them so that the findings and interpretations would be less questionable.

Because the findings from the Sustaining Effects Study are intended to serve many evaluation purposes, we will first briefly describe the objectives of the study in the next section. Then, the specific purpose of this report will be noted in the context of the general objectives of the study.

OBJECTIVES OF THE SUSTAINING EFFECTS STUDY

The objectives of the study are implicit in the list of design improvements presented in Table 1-1. The major objectives are discussed briefly below, along with references to the reports that address them. A summary of the findings in the completed reports can be found in the general introduction to the study.

Description of Student Selection for CE as It Relates to Economic Status, Achievement, and Home Environment. The Education Amendments of 1974 required several studies to inform the Congress concerning the reauthorization of the Title I program in 1978. One of the major questions posed by the Congress was who received the services provided by Title I funds. Some members of Congress considered changing Title I to stress economic disadvantage less and educational disadvantage more in the distribution of funds to districts and schools. In the discussion of this issue, Congress wanted information on the following questions:

- How many economically needy children are and are not selected for Title I services?
- How many educationally needy children are and are not selected for Title I services?
- How is selection for Title I services related to economic and educational status of the students?

In addition, the Federal Agency needed to know:

- What kinds of educational services are received by the economically and educationally disadvantaged children that are different from those received by non-disadvantaged children?
- How are selection for Title I services and academic achievement related to the children's home environments, parents' participations in and awareness of their children's educations, and parents' satisfactions with the educational services their children receive?

These questions were all addressed in Technical Reports 2 (Breglio, Hinckley, and Beal, 1978), 3 (Hinckley, Beal, and Breglio, 1978), and 4 (Hinckley, Beal, Breglio, Haertel, and Wiley, 1979) from the Participation Substudy of the Sustaining Effects Study.

Table 1-1

Improvements in the Design of the Sustaining Effects Study in Order to Overcome the Shortcomings of Previous Evaluations

Shortcoming of Previous Evaluations	How Shortcoming is Addressed in the SES
Studies rarely followed students for more than one year, so long-term or cumulative effects of CE could not be reflected in the findings.	The SES follows students, their growth, and their educational services for three school years, and also collects information on summer experiences.
Only certain grades were selected, so differential effects over the important early development years could not be determined.	The SES sampled children in all six of the elementary grades, maintains a large sample in each grade, and analyzes data separately by grade or cohort.
Schools and students were generally selected for specific comparisons only, so descriptions of the national state of affairs could not be made with much accuracy.	The SES has a nationally representative sample which has supported statistics projected to the national population with quite small sampling errors.
Achievement growth measured in terms of national norms was very questionable because of the unfounded assumptions on which the norms were interpolated and extrapolated.	The SES developed its own norms, based on fall and spring test administrations, that do not depend on any testing-time interpolations or extreme-score norm extrapolations.
Norms for the published achievement tests were based on samples that were under-representative of the kinds of students likely to receive CE, clouding the meaning of the findings. The items of the tests were sometimes suspected of being biased against those students.	The SES norms were developed from the sample that was fully representative of poor, minority, urban, and low-achieving students. Test items were analyzed for racial/ethnic bias and were eliminated from the study and from the norms when found to be biased.
The relevance of the achievement tests to the lives of disadvantaged students was questioned as the real cause of poor performance	The SES developed a new achievement measure that stressed relevance to the everyday lives of students from a wide spectrum of conditions.
Selection for receipt of CE was frequently equated with the actual receipt of supplemental or remedial services. CE was often considered as a single and uniform treatment.	The SES collects information on selection for CE and receipt of instructional services independently, so their relationships can be empirically studied. Various CE treatments can be examined separately.
Costs for educational services were based on district expenditure figures, with the assumptions that all students shared equally and that all expenditures could be presumed to have direct effects on student growth.	The SES develops cost estimates for each student, based on the direct instructional services and resources the student receives. Costs for such things as buildings and administration are not included.
Comparison students for those receiving CE were clearly very different in many respects, in addition to their non-receipt of CE services.	The SES has many different and clearly definable comparison groups, so findings can be interpreted in light of the differences between the groups.
Measures of critical variables, such as socio-economic status, costs, achievement, and services were frequently analyzed at the school level, possibly masking effects at the student level.	The SES measures many of the critical variables at the student level, and aggregates the data when school-level indexes are needed.

Description of the Nature of CE Programs, Characteristics of Participating Students, Schools, and Educational Services. The Participation Study dealt almost exclusively with what has been called 'selection for CE or Title I services', without examining too closely what such programs really are and how they differ from the programs regularly offered by the schools. In order to draw the relationships between participation in a CE program and the educational progress of students, we must be assured that there really is a distinct program that can be specified in some way, and has a reasonable chance of making an impact. As will be seen in the present report and in future reports, not only do we analyze data on the basis of program participation, but we also consider the actual services received, in order to address directly the possible differences between the intention and the actuality. Based on the analyses of data obtained from about 81,500 students in the representative sample, Technical Report 5 (Wang, Hoepfner, Zagorski, Hemenway, Brown, and Bear, 1978) provides detailed descriptions of the nature and recipients of compensatory services.

Evaluation of the Cost-Effectiveness of Compensatory Education. In its deliberations for the reauthorization of Title I and in annual appropriation hearings, Congress also wants to have information on the effectiveness of the program relative to its cost. While it appears eminently sensible to ask the question of cost-effectiveness, it is difficult to provide the answers in a manner that will be interpreted correctly.

In the study of cost-effectiveness of CE, efforts were made to preclude enigmatic conclusions and, at the same time, to make cost estimates on a sounder basis than in the past. In Technical Report 6, Haggart, Klibanoff, Sumner, and Williams (1978) develop and present a model that translates educational resources for each student into estimates of average or standard dollar costs for his/her instructional program. The model is thus called a resource-cost model, which results in a cost index designed to represent the labor-intensity of services without being confounded with regional price differentials, different accounting methods, etc. The report also compares services received by students in different CE programs in terms of the cost measure.

In Technical Report 7, Sumner, Klibanoff, and Haggart (1979) relate resource-costs to achievement growth in order to examine the cost-effectiveness of compensatory programs.

Assessment of the Effects of Summer-School Programs. The study has also examined the result of attendance at summer schools, because of the interest of members of Congress and program administrators in knowing if such attendance prevents the presumed progressive achievement deficit of low-achieving students. In particular, there is a concern about the validity of the 'summer drop-off' hypothesis which stipulates that there is a loss of learning during the summer recess, especially for low-achieving students. The effectiveness of summer schools and the hypothesis of 'summer drop-off' are addressed in Technical Report 8 (Klibanoff and Haggart, 1980).

Investigation of the Effects of Discontinuing Compensatory Services. Springing from the same concern to find an explanation for the presumed widening achievement gap, it has been hypothesized that strict conformance to rules and guidelines for CE programs, causing the discontinuation of CE services when students' achievement rose above their schools' cutoff levels for program participation, results in the students' losses of the gains attributable to the CE programs.

For a clarification of this issue, it is important to learn what happens to students when their participation in compensatory programs is discontinued. Whether the effects of CE are sustained and how services provided to students are changed after their compensatory services cease are studied in Technical Report 11 (Kenoyer, Cooper, Saxton, and Hoepfner, 1981). (The question 'what services are effective for sustaining the effects of CE after its discontinuation' will be addressed in a later report, Report 15.)

Evaluation of Long-Term Effects of CE and Study of Effective Educational Processes. The present report and the reports yet to come from the Sustaining Effects Study will address the effects of educational practices on raising student achievement levels, with special attention to the practices found in CE programs in general and in Title I programs in particular. The analyses in this report employ only the first-year data, while later studies of impact will either be based on three-year longitudinal data or will be based on interviews and in-depth observations of what happens in the classrooms. The extensive achievement data collected from overlapping cohorts of students in the three years will be utilized to describe the pattern of educational growth over the years for various groups of CE and non-CE students. The analyses of longitudinal data will allow us to examine further the sustained effects of CE and help us determine if the presumed phenomenon of gap-widening between the disadvantaged and non-disadvantaged students indeed exists.

THE PURPOSE AND OBJECTIVES OF THE PRESENT REPORT

This report is based only on data from the first year of the study, that is, on information about services and educational progress for a nationally representative sample of students and for students from purposively selected samples. The students' educational development is examined to evaluate the effects of compensatory services on both their achievement growth and attitudinal changes. Another objective is to study the relationship between educational development and amount of services received as well as characteristics of instructional programs.

The assessment of students' achievement growth during the school year is an important part of the evaluation of compensatory education for many reasons, including the debate noted earlier about the pattern of growth over the summer (David and Pelavin, 1978). For example, in order to understand possible differences in the development process between the school-year period and the summer period, a thorough examination of the effects of instruction on growth during the school year is necessary. What occurs in the school year can provide a baseline reference for assessing growth between the school years.

There are four reasons for this report. First, using all the data obtained in the first year, *the findings are based on a nationally representative sample of schools and their students* (because of funding limitations, the three-year longitudinal data base contains data from a reduced sample; see a later section for a description of the sample).

The second advantage of analyzing the entire first-year is that *the norms of achievement tests were established empirically* using data collected that year from students in the representative sample of schools. (The norms created specifically for this study are referred to as the SES norms in this report.) This allows us to examine the achievement growth of different groups of students in comparison with the projected population growth for the same time interval. It should also be noted that there is an important difference between the norms we use and the traditional norms which the publishers provide: almost identical groups of students were tested in the fall and spring with two adjacent levels of tests to supply data for the construction of the norms. Such truly empirical norms are still lacking for some major tests. Besides, publisher's norms are seldom created in the same year as the data are collected for the evaluation, and thus may not represent the current population because of demographic changes. (There is a similar concern about the timeliness of the norms in the analyses of the longitudinal data from this study.)

The third reason for this report is that *the study serves as a guide for the later reports* in the generation of hypotheses and selection of appropriate analytical approaches. Reasonable hypotheses can be formulated when potential rivals have been tested with the first-year data. In addition, approaches that were found to be particularly fruitful in these early analyses can be emphasized in the longitudinal study. Last, *the report provides results at an earlier date* so that policy and decision makers will have reliable preliminary findings prior to the final reports of the study.

ISSUES AND QUESTIONS ADDRESSED IN THE REPORT

The questions addressed in this report were formulated in response to the USOE's needs for information, the concerns of the Title I program staff, and the advice from the Policy and Research Advisory panels convened for the study. The questions were originally stated in the context of the multi-year evaluation as follows:

- Does compensatory education result in benefit to students' educational growth?

- To what extent do compensatory services narrow the achievement gap between disadvantaged and non-disadvantaged students?

- At what level of effort is narrowing of the gap detectable?

- For various intensities and durations of participation, what grade levels profit most from compensatory services?

- What kinds of services result in the greatest educational growth?

- What kinds of services are effective at different grade levels?

- What kinds of students profit most from what kinds of services?

Two major issues were addressed in these questions: the first four concern the effects of CE on reducing the anticipated educational deficit of its participants, and the last three deal with the relationship between students' educational development and characteristics of educational processes.

Questions derived from these study issues that guided the analyses for this report are listed below (these questions are formulated to emphasize specifically the confinement of the analyses to the one-year data):

- During the school year, do CE students demonstrate greater educational development than expected of them without compensatory services?

- Within a school year, do the instructional services delivered to CE students result in a reduction of the anticipated achievement gap between them and non-CE students?

- What is the critical level of effort for reducing this anticipated achievement gap?

- Does compensatory education have greater effects on the participant's achievement growth at some grade levels than at others? Are the effects different for students who did and who did not participate a year earlier? And, does this pattern of differences vary with the amount of services provided?

- How are instructional services, school environment, and educational methods related to educational development?

- Are the characteristics of effective educational programs different by grade levels?

- Are the effects of various educational dimensions associated with student characteristics?

Answers for these questions are presented in the next seven chapters following the same order. Each chapter addresses one specific question and relates the findings to those in other chapters.

PRESENTATION OF FINDINGS

The remaining chapters of this report are divided into two parts, addressing two major issues:

- Part I, The Effects of Compensatory Education and Instructional Services.

  There are four chapters (2 through 5), discussing the effectiveness of CE in raising student achievement levels and in changing attitudes; the role of instructional services in effecting achievement growth; the critical amount of effort required to produce a noticeable reduction in achievement deficits of CE students; and the differential effects of CE at different grades and for different previous experience with CE.

- **Part II, The Relationships Between the Educational Process and Educational Development.**

  There are three chapters (6 through 8), examining relations of educational development with characteristics of educational processes and amount of instructional services; variations of these relations among grades; and interactions of student characteristics with effective practices.

In the rest of this chapter, we describe the sample and the data that are analyzed in this report, examine how the attrition of data may affect the conclusions of our analysis, present a general discussion of the analytic approaches, and address some technical concerns. These materials are intended to prepare the reader for a better understanding of the analyses and help him/her see matters in perspective. Without much loss of continuity, the readers who are anxious to learn the results may skip the subsequent sections and proceed to other chapters. While reading the report, the reader may be confronted with the issues that are addressed in these sections and wish to return to this chapter for some discussion. Those who would rather have a preview of the issues before confronting them in the remaining chapters, may read the following sections entirely or selectively depending on their interests.

For the benefit of those readers who would like to skip to the other chapters, we would advise them to become familiar with the achievement data for the students included in our analyses, as summarized in Tables 1-2 and 1-3, so that they can better understand the discussion of student growth. Additionally, we note that with regard to the problem of data attrition, it is concluded that the problem is not serious (the rates of missing data are moderate) for the school-year analyses and, in general, is expected to have little influence on the validity of our results.

DESCRIPTION OF THE DATA BASE AND ITS ORGANIZATION

The Sample. The data that support this report come from the complete first-year sample of the SES (see Technical Report 1, Hoepfner, Zagorski, and Wellisch, 1977, for a detailed description of the selection of these samples). The complete sample actually consists of four different samples. The first and largest sample is the nationally representative sample consisting of 242 schools (about 83,500 students) selected on a stratified-random basis so that data from districts, schools, and students can be accurately projected to the national population.

Twenty-nine schools belong to the comparison sample (about 12,000 students), a sample purposively selected to supply an adequate number of schools that have no CE programs but serve large numbers of students from low-income families. Because of the wide availability of CE programs, such schools are not common, but their students provide a very important comparison group for CE students: their low-achieving students are in need of special assistance but are not provided with compensatory services, nor is there any possibility that they might indirectly benefit from 'spillover' of such services provided to other students in the schools.

A third sample comprises 14 'feeder/feed' schools that enroll about 5,000 students who either have attended or will attend schools in the representative and comparison samples. This extra sample was necessitated by the fact that some schools with grades in the 1-6 range serve only a restricted range of grades, and receive students from or send them to other schools to complete the six elementary grades. Inclusion of this sample enables the study to follow those students who transfer to other schools because of the restricted range of grades in their schools.

A fourth sample is composed of 43 schools (about 20,000 students) nominated as exemplary CE schools. These schools generally have a high enrollment of poor students who participate in CE, and their CE programs have been recommended as being innovative and promising in raising achievement. The purpose of this sample was to ensure the inclusion of schools that had good chances of demonstrating the effectiveness of CE programs.

All 328 schools provide data for at least some of the analyses presented in this report.

Table 1-2

Reading Achievement Scores for the First-Year Sample by Availability of the Fall and Spring Scores

Sampling Status of Schools*		Entire Sample		Representative Schools***		Comparison Schools		Nominated Schools	
Availability of Scores**		Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring
Grade 1									
Fall	N	16,893	2,563	11,839	1,809	1,722	279	3,095	442
	Mean	344.41	334.57	347.25	336.22	339.04	331.72	336.07	329.13
	S.D.	33.37	33.06	32.99	33.17	33.97	33.30	32.51	31.18
Spring	N	16,893	2,289	11,839	1,547	1,722	308	3,095	415
	Mean	409.15	394.43	412.54	396.64	401.29	395.24	400.00	384.98
	S.D.	46.23	45.92	46.13	45.81	44.84	49.13	45.79	42.65
Grade 2									
Fall	N	15,545	2,110	10,809	1,433	1,641	215	2,887	418
	Mean	415.55	401.71	420.25	403.95	411.33	399.80	399.37	393.50
	S.D.	49.89	50.53	50.00	51.48	47.91	45.59	47.27	49.61
Spring	N	15,545	1,887	10,809	1,225	1,641	281	2,887	346
	Mean	458.58	443.32	463.80	445.96	450.79	449.93	442.26	426.71
	S.D.	53.10	52.50	53.68	53.63	49.33	45.27	49.48	50.76
Grade 3									
Fall	N	15,406	1,923	10,834	1,241	1,512	227	2,850	391
	Mean	459.72	442.13	464.49	445.05	454.02	444.50	443.60	429.36
	S.D.	55.07	54.58	55.13	55.53	51.29	50.51	53.54	53.59
Spring	N	15,406	1,796	10,834	1,193	1,512	260	2,850	322
	Mean	493.26	476.15	498.14	481.71	483.57	472.27	478.53	457.80
	S.D.	56.92	55.53	57.27	55.99	50.74	45.20	55.36	57.87
Grade 4									
Fall	N	15,470	1,747	10,671	1,196	1,650	185	2,550	331
	Mean	492.82	474.38	499.01	475.88	481.68	476.03	474.13	469.40
	S.D.	62.16	62.52	62.35	62.72	59.01	60.10	57.84	62.59
Spring	N	15,470	1,572	10,671	1,066	1,650	208	2,550	269
	Mean	522.52	505.05	527.97	508.60	514.53	498.64	504.29	494.88
	S.D.	63.74	61.66	63.52	63.11	60.52	56.26	62.00	60.03
Grade 5									
Fall	N	16,250	1,676	11,037	1,102	1,579	188	2,382	279
	Mean	523.31	502.64	530.05	505.31	516.68	508.41	501.93	493.23
	S.D.	65.42	67.68	65.58	67.75	61.02	63.49	62.12	69.84
Spring	N	16,250	1,466	11,037	972	1,579	154	2,382	246
	Mean	550.44	530.08	557.43	535.34	545.27	530.24	527.42	510.33
	S.D.	69.37	66.79	69.86	68.90	61.88	60.68	65.61	59.03
Grade 6									
Fall	N	18,739	1,668	13,331	1,083	1,367	197	2,041	198
	Mean	555.22	533.30	562.79	537.71	541.76	537.01	528.40	516.89
	S.D.	69.55	69.49	68.56	70.70	69.09	60.27	66.42	63.44
Spring	N	18,739	1,460	13,331	959	1,367	146	2,041	173
	Mean	580.29	556.89	588.07	563.86	567.22	543.10	554.11	538.82
	S.D.	72.18	70.78	71.34	71.12	69.85	65.31	68.45	70.72

*The sample of students in the Feeder Schools was not tabulated because of the small number of students. Thus, the N's for the Representative, Comparison, and Nominated Schools do not add up to the N for the entire sample.

**The 'Fall or Spring' heading indicates the group with fall scores but no spring scores where fall achievement is described, while it indicates the group with spring scores but no fall scores where spring achievement is described.

***The national projections give means very close to those shown here for the group of students in Representative Schools who have both fall and spring test scores. Please refer to Table 1-12 of SES Technical Report 9 for the national projections.

Table 1-3

Math Achievement Scores for the First-Year Sample by Availability of the Fall and Spring Scores

Sampling Status of Schools*			Entire Sample		Representative Schools***		Comparison Schools		Nominated Schools	
Availability of Scores**			Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring
Grade 1										
	Fall	N	16,858	2,551	11,815	1,789	1,716	284	3,090	445
		Mean	330.85	322.52	333.51	323.86	325.73	320.74	323.75	318.09
		S.D.	35.68	36.52	35.03	36.35	37.20	38.65	36.10	35.13
	Spring	N	16,858	2,292	11,815	1,562	1,716	302	3,090	409
		Mean	392.38	379.06	394.86	381.28	384.20	377.65	387.41	370.69
		S.D.	45.24	45.16	44.92	44.20	44.80	49.81	45.53	43.27
Grade 2										
	Fall	N	15,513	2,082	10,791	1,415	1,638	206	2,876	417
		Mean	392.73	379.80	396.71	382.10	388.70	377.74	379.64	372.98
		S.D.	45.32	44.84	45.01	45.10	42.94	42.18	45.58	45.87
	Spring	N	15,513	1,892	10,791	1,228	1,638	285	2,876	346
		Mean	448.01	432.84	452.62	435.67	441.27	436.31	434.35	418.88
		S.D.	51.67	50.75	51.11	50.03	51.34	52.15	51.64	50.70
Grade 3										
	Fall	N	15,390	1,925	10,815	1,253	1,522	222	2,843	386
		Mean	443.13	429.05	446.82	432.47	437.50	428.64	431.64	418.37
		S.D.	49.91	52.46	48.85	52.88	50.84	49.01	51.67	50.68
	Spring	N	15,390	1,790	10,815	1,191	1,522	253	2,843	326
		Mean	500.36	484.09	505.78	489.80	489.45	479.20	483.97	464.76
		S.D.	57.81	58.27	57.35	58.06	55.62	52.20	56.24	58.86
Grade 4										
	Fall	N	15,431	1,761	10,639	1,210	1,647	187	2,546	329
		Mean	494.67	477.41	500.17	480.27	484.81	473.48	477.68	469.50
		S.D.	60.44	62.28	59.49	62.44	57.78	60.02	61.06	63.09
	Spring	N	15,431	1,572	10,639	1,064	1,647	207	2,546	270
		Mean	544.85	527.98	550.17	533.25	537.96	523.16	526.85	511.34
		S.D.	65.72	64.61	65.49	64.83	64.54	63.09	63.79	62.62
Grade 5										
	Fall	N	16,234	1,673	11,022	1,105	1,588	180	2,376	280
		Mean	539.26	517.38	545.37	521.19	534.01	515.74	520.32	506.48
		S.D.	65.22	66.62	64.72	65.10	62.56	69.82	66.26	71.48
	Spring	N	16,234	1,455	11,022	968	1,588	147	2,376	246
		Mean	583.49	564.43	590.58	569.46	579.15	560.68	562.06	547.65
		S.D.	73.52	68.88	73.76	70.15	71.57	67.23	65.91	65.38
Grade 6										
	Fall	N	18,699	1,663	13,305	1,081	1,359	201	2,040	187
		Mean	581.81	559.32	587.91	561.99	572.92	563.73	560.72	549.89
		S.D.	69.95	71.00	68.94	68.72	68.45	69.05	70.01	73.68
	Spring	N	18,699	1,471	13,305	968	1,359	146	2,040	178
		Mean	621.70	598.37	627.59	604.86	614.82	589.35	602.70	586.94
		S.D.	77.99	75.03	77.71	74.76	77.40	78.87	73.94	76.05

[*] The sample of students in the Feeder Schools was not tabulated because of the small number of students. Thus, the N's for the Representative, Comparison, and Nominated Schools do not add up to the N for the entire sample.

[**] The 'Fall or Spring' heading indicates the group with fall scores but no spring scores where fall achievement is described, while it indicates the group with spring scores but no fall scores where spring achievement is described.

[***] The national projections give means very close to those shown here for the group of students in Representative Schools who have both fall and spring test scores. Please refer to Table 1-12 of the SES Technical Report 9 for the national projections.

The Organization of the Data Base. The data base is organized at the student level. Data at the teacher, classroom, or school level were then disaggregated to the student level, with the full realization of the effects of this approach on the estimates of variance of the disaggregated measures. The data were extracted from all the first-year instruments (Hemenway, Wang, Kenoyer, Hoepfner, Bear, and Smith, 1978). (Sample copies of the instruments not under copyright are reprinted in Report 9A, The SES Project Staff, 1979.) As a review, we briefly describe, in the following paragraphs, the measures that are used in the analyses for this report.

Outcome Measures Describing Students' Educational Development. Three measures belong to the category of student outcomes—the results by which educational programs are frequently evaluated.

The Comprehensive Tests of Basic Skills (CTBS), Form S, was administered to each student in the sample, both in the fall and the spring of the school year. Because many of the students in the sample are low achievers (schools were selected by strata to ensure that such students, eligible for CE services, were included in sufficient numbers), each student was administered two levels of the CTBS: the one prescribed by the publisher as appropriate for each grade and another one level below. In this manner, we could select test data that were not from a test too difficult for the students. In the analyses of this report, we use primarily what we have termed the 'recommended level' of the CTBS (the one that resulted in smaller floor and ceiling effects for each grade in each school), but at times data from both of the levels are required for the analyses.

Subscales of the CTBS were selected to provide indexes of achievement in reading and in math. Because we had obtained good national data from the representative sample and because most children provided scores from two adjacent levels of the test, we created norms and vertical scale scores (VSS). These norms and scales served the additional advantage that they provided test-score conversions that did not under-represent students who are poor, low-achieving, or minority, as was sometimes the case in publishers' standardization samples. In addition, both fall and spring norms were based on empirical test scores at all grades, and not on extrapolations or interpolations. (See Hemenway et al., 1978 for details of the procedures for creating norms and VSSs.)

Because CE students are largely from minority groups, and from families of low economic status, it is important to remove any possible socio-cultural biases in the test employed in the evaluation. The publisher of the CTBS had carried out a study to eliminate items that were judged as possibly biased. Nevertheless, in order to ensure that the potential bias against disadvantaged and minority students was minimized, SDC also conducted an independent debiasing study. The study identified eight items from the reading subtests as being statistically and culturally biased. Each test was then rescored by omitting these biased items to obtain the so-called 'debiased score'. For this report, only the debiased scores are used in the analyses.

In response to the concern about the relevance of standardized achievement tests, especially for poor, low-achieving, or minority students, the study also administered to students in grades 4, 5, and 6, in the fall and spring, a Practical Achievement Scale (PAS). The PAS presents students with pictorial items of everyday relevance that measure ability to solve problems requiring both reading and math skills. Because the test is relatively short (30 items) and because only one level was developed, the raw scores are employed in the analyses.

The third measure of outcome is the Student Affective Measures (SAM), a test of attitudes toward reading, math, and school in general. This measure was included in order to assess what effects CE programs might have on students' attitudes, because many believe that changes in attitudes may be the initial and important outcomes of such programs. The SAM, like the CTBS and PAS, was administered in both the fall and spring of the school year. (Students in grade 1 were not administered the SAM in the fall, because their attitudes were expected to be formed mostly by preconceptions.) Students in grades 1 through 3 were administered a primary version and students in grades 4 to 6 were administered an intermediate version. The intermediate version was parallel to the primary, except that items addressed the more academic aspects of reading and math that the students were engaged in, instead of the simple activities of the primary form.

Measures of Instructional Services Received by the Students. Three measures of the receipt of instructional services were obtained for each student. The Student Participation and Attendance Record—Reading (SPAR) and the Student Participation and Attendance Record—Math (SPAM) were completed by teachers for each of their students four times during the school year. For each administration of the SPAR and SPAM, which was to cover a two-month period, the student's reading and/or math teacher(s) estimated the percentage of the student's reading (or math) instructional time that was spent in groups of various sizes and with various kinds of instructional personnel during a typical week. The teacher also provided the total number of hours the student participated in reading (or math) instruction during the record week.

The number of hours during the week was then multiplied by the number of weeks to provide a total number of hours for the two-month period, which was in turn adjusted by the students' attendance records and reports of unusual occurrences (such as snow storms, epidemics, etc.) that reduced instructional time. The bimonthly totals were then further adjusted for the length of the school year that was reported by the principal. The total hours could then be multiplied by the weighted average of the percentages of time in each of the ten instructional arrangements to obtain the total number of hours per year that each student spent in each arrangement. In this report we occasionally analyze instructional time under each of the ten arrangements. However, for the sake of simplicity and based on previous findings that some arrangements differentiated CE students from others (see Technical Report 5), we frequently group the instructional arrangements into only three types that are conceptually distinct (see later chapters for descriptions of these composites).

The third measure of instructional services is the Summer Activity Slipsheet (SAS), completed by all students in grades 2 through 6. The scores from this instrument reflect the amounts of intellectual experience the student has had during the previous summer in reading and in math. The scores are heavily weighted by attendance at summer school where there was instruction in reading or math, but also give some consideration to other activities that engaged the children's minds in intellectual activities.

Measures of Student Characteristics. The Student Background Checklist (SBC) was completed for each student by his/her homeroom teacher. This instrument collects demographic and past-experience data on each student. Information from the SBC that is used in this report includes each student's race/ethnicity, early-childhood schooling experience, participation in free or reduced-price meals, previous CE receipt, parents' educational attainments, judged need for CE, and parental involvement in child's education. For the first year, this instrument was completed between late October and early November.

Selection for Compensatory Services. The instrument critical for the categorization of students into the various analysis groups is the Compensatory Education Roster (CER). This instrument was completed in the winter and updated in late spring by the coordinator at each school, and provided binary information on each student's selection for several kinds of compensatory services. The responses on the CER were partially validated against information obtained from the school principal and from the district. For instance, if both the principal and the district business manager indicated that a specific program did not exist in the school, then false responses of receiving CE under the program were erased. Because all our analyses are performed separately for reading and for math, and because the major CE distinctions are Title I, Other-CE, and no CE (modified by school receipt of CE to account for within-school 'spillover' effects), the responses from the CER are scored to reflect these groupings.

Resource-Cost Data. The instructional services measured by hours, supplemented by the amount of usage of various materials and equipment, were translated into resource-costs, as described in Technical Report 6 (Haggart et al., 1978). The weighted composite of service intensities was found to provide sensitive discriminations among students who received different kinds of compensatory services (see Technical Reports 6 and 11), and was also used in this report.

Demographic Information. Where the analyses require information on demographic characteristics of the schools, such as region and urbanism, these data were taken from the sampling files used in creating the sample of the schools (see Technical Report 1).

Data Describing Schools. Some analyses in this report use school characteristics as independent variables or as grouping variables. Most of these variables are composites developed from items in the Principal Questionnaires (PQA and PQB), and in the Teacher Questionnaires (TQA, TQB, and TQC). Other school-level variables are obtained by aggregating student-level data, e.g., school's minority concentration and poverty concentration.

Data at the Teacher Level. Teachers completed, when appropriate, one questionnaire about their reading instruction (Teacher Questionnaire B, TQB), one questionnaire about their math instruction (Teacher Questionnaire C, TQC), and one about themselves (Teacher Questionnaire A, TQA). As in all cases in this report, the reading and math information are kept separate and analyzed with their respective outcome measures. Teacher-level data are often disaggregated to the students. In cases where a student has only one teacher (the majority of cases, see Technical Report 9), the disaggregation is a simple matter. But many students receive reading and/or math instruction from more than one teacher. The responses from the first-named and second-named teachers on the Student-Teacher Linkage Record (STLR) were averaged prior to disaggregation to their students, as there was no accurate way to weigh the teacher's responses differentially. Because less than 3 percent of the students received instruction from a third-named teacher in either reading or math, data from third-named teachers were not included in the disaggregated averages. (It was assumed that third-named teachers did not spend much time with those students for whom they were third-named.)

For this report, most analyses consider only composites from the items in the teacher questionnaires, which are described in Technical Report 9. In general, the composites characterize 'qualifications' of teachers and their 'classroom instructional practices'.

Appendix A1 provides a list of all the variables contained in the data base for this report, and the instruments from which they come. Note that some of the variables listed do not appear in the report—they were included for preliminary analyses (that are not reported) in the anticipation that they would prove useful.

THE PROBLEM OF INCOMPLETE DATA (ATTRITION DURING THE SCHOOL YEAR)

An inevitable problem for survey studies is that data are missing for various reasons for some of the cases being studied. Missing data may threaten the internal validity of the analyses (Campbell and Stanley, 1966). There are two aspects of the effects of incomplete data that are important in the analyses. First, missing data not randomly distributed throughout the cases can bias the estimates of sample statistics and population inferences. Attempts to reduce this bias through Bayesian imputation of data have been investigated (Rubin, 1977, 1978). Second, the usable data themselves can be affected in multivariate analyses because if one or more critical data points are missing, the entire case is usually deleted from the analysis. Methods have been developed for estimating the complete data variance-covariance matrices that are the basis for multivariate analyses, so that the effects of the missing data are minimized or eliminated (Afifi and Elashoff, 1966, 1967; Timm, 1970; Gleason and Staelin, 1975; Frane, 1976).

For this report, where the emphasis of the analyses is to learn the relationships between achievement and educational variables, rather than to describe populations, the problem of missing data is not expected to be very serious in distorting the data structure. Although techniques for estimating variance-covariance matrices or correlation matrices when some cases have incomplete data are available, they are generally used when sample sizes are small and missing data will reduce the N drastically so as to render all estimations quite biased (see references cited above). In view of the large amount of data available for the present analyses and the careful quality control and imputation of missing responses, wherever appropriate, from other responses on both logical and statistical bases (see Technical Report 9), we have not adopted any further imputations or corrections for missing data in our analyses.

Nonetheless, in order to assess the seriousness of missing data and their effects on the results of our analyses, we prepare tabulations of attrition rates by student characteristics, and describe the distributions of important measures (such as achievement scores) for groups of students who supply various amounts of data. (See Trismen et al., 1975; and Molitor, Watkins, and Napior, 1977 for examples of similar ways to deal with the problem of missing data.) In addition, Zagorski, Jordan, and Colon (1981) examine the attrition of data in the first year and a half of the study. Their results may be consulted to obtain a general picture of the problem of attrition in this study. However, we note that these results need not be appropriate for the present report as the nature of student attrition between school years is quite different from that within the school year and the attrition rate over the summer is usually much higher than during the school year. On the whole, the problem of attrition is expected to be more serious in the multi-year analyses than in this report.

Missing Data for Achievement Scores

Tables 1-2 and 1-3 present tabulations of CTBS scores by grade and by sample. The mean scores for groups with missing data (fall or spring) are lower in all cases than the corresponding means for groups with complete data (fall and spring), but the standard deviations (s.d.) for both groups remain large and near the population values reported in Technical Report 9. In each case, the difference between group means is about or less than .3 standard deviation for the complete-data group. Therefore, it is safe to conclude that the score distributions for the groups with missing and with complete data are extensively overlapped. The groups with incomplete test data are not concentrated in a narrow score range.

In passing, it may be noted that the means and standard deviations for the complete-data group in the representative sample are about identical to the nationally projected values presented in Table 1-12 of Report 9. This indicates that the unweighted data approximate those in the population quite well, even after the exclusion of cases with incomplete data. These tables also show that the average scores for students in the nominated sample and for those in the comparison sample are always lower than the projected population means, while the corresponding standard deviations are quite similar to those for the population. The lower achievement levels for the students in the purposive samples are expected in light of the sampling criteria (see Report 1 for these criteria).

Based on the first-year representative sample of schools, the percentages of students having both fall and spring scores range from 78 to 87 for reading and for math, and increase with grade level. For all six grades combined the percentage is 82.2 for reading and for math (see the first row of Table 1-4). In total, 9.4 percent have only fall scores and 8.4 percent have only spring scores. These percentages are similar to the 10 percent missing for each of the pretest and posttest scores reported in the Compensatory Reading Study (CRS). They also compare well to the principals' estimates of mobility, indicating that, during a school year, 9.1 percent of the students move into the school's attendance area and 8.4 percent move out (see Technical Report 9).

Missing Data for Other Student-Level Measures

Table 1-5 provides counts of missing data for the Student Background Checklist (SBC), Compensatory Education Roster (CER), and Student Participation and Attendance Record in reading and math (SPARM), along with rates of missing data from the entire first-year sample. It can be seen that the CER has the lowest rate of missing data (3.30 percent overall), while the SPARM has the highest rate (6.88 percent overall). For all three instruments, as well as for the CTBS scores, the rate of missing data is greater in the early grades and decreases in the higher grades.

The Relationship Between Student Characteristics and Missing Achievement Data

CE Status. Means and standard deviations of CTBS scores for students with complete and with some missing data are presented in Tables 1-6 and 1-7, by CE category. To the extent that the statistics are similar for the two groups, the achievement distributions are also similar and the missing-data group can be assumed to be random with respect to achievement. On the other hand, substantially different statistics, indicating that the group with missing data has different achievement, would suggest that analyses based only on the cases with complete data are likely to produce misleading conclusions.

Table 1-4

Percentages of Complete and Missing Reading and Math Scores From the Representative Sample for the First Year, by Grade

Availability of Scores	Grade 1	2	3	4	5	6	Total
			Reading				
Fall and spring scores	77.9	80.3	81.7	82.5	84.2	86.7	82.2
Fall scores only	11.9	10.6	9.4	9.2	8.4	7.0	9.4
Spring scores only	10.2	9.1	9.0	8.2	7.4	6.2	8.4
Total	100.0	100.0	100.1	99.9	100.0	99.9	100.0
			Math				
Fall and spring scores	77.9	80.3	81.6	82.4	84.2	86.7	82.2
Fall scores only	11.8	10.5	9.5	9.4	8.4	7.0	9.4
Spring scores only	10.3	9.1	9.0	8.2	7.4	6.3	8.4
Total	100.0	99.9	100.1	100.0	100.0	100.0	100.0

Table 1-5

Number of Cases and Missing Data Rate for Student Background Checklist (SBC), Compensatory Education Roster (CER), and Student Attendance Record in Reading and Math (SPARM)

Grade	SBC		CER		SPARM		Total Number of Records
	Number	Percent	Number	Percent	Number	Percent	
1	1,380	6.33	835	3.83	1,710	7.85	21,789
2	1,207	6.17	706	3.61	1,559	7.97	19,566
3	1,134	5.92	664	3.47	1,357	7.08	19,161
4	1,059	5.63	580	3.08	1,222	6.49	18,826
5	1,035	5.33	600	3.09	1,241	6.39	19,424
6	1,084	4.95	596	2.72	1,217	5.56	21,899
All	6,899	5.72	3,981	3.30	8,306	6.88	120,665

Table 1-6

Reading Achievement Scores for the First-Year Sample by Availability of the Fall and Spring Scores and Reading CE Status

Reading CE Status		Title I Students in Title I Schools		Other-CE Students in Title I Schools		CE Students in Other-CE Schools		Non-CE Students in Title I Schools		Non-CE Students in Other-CE Schools		Students in Non-CE Schools	
Availability of Scores*		Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring
Grade 1													
Fall	N	2,785	238	987	99	574	63	7,140	1,325	3,238	497	2,151	321
	Mean	323.89	321.17	337.27	333.47	333.06	331.70	348.53	333.64	357.96	344.14	342.51	335.25
	S.D.	28.94	28.49	30.08	32.48	35.02	31.34	32.02	32.43	31.26	32.75	33.32	35.63
Spring	N	2,785	284	987	107	574	55	7,140	631	3,238	256	2,151	174
	Mean	383.12	375.42	396.86	383.29	390.24	388.53	416.17	395.45	423.60	409.16	408.50	407.77
	S.D.	40.55	39.26	44.70	45.57	46.32	49.19	44.19	45.62	45.81	48.26	44.64	44.55
Grade 2													
Fall	N	3,036	181	948	98	704	76	6,027	1,095	2,842	373	1,954	262
	Mean	380.80	366.23	405.55	387.68	387.86	382.68	426.33	403.34	441.83	423.36	413.40	400.71
	S.D.	38.05	41.52	47.19	53.88	43.85	41.98	46.43	49.68	46.55	48.89	48.49	45.81
Spring	N	3,036	218	948	88	704	38	6,027	526	2,842	206	1,954	168
	Mean	423.48	406.74	446.86	429.49	433.82	425.50	469.54	447.65	485.24	468.77	455.56	453.10
	S.D.	42.71	44.65	51.61	52.57	46.95	38.08	50.44	51.78	48.27	45.67	50.97	45.54
Grade 3													
Fall	N	3,022	198	884	83	629	57	5,977	923	2,927	360	1,938	276
	Mean	415.60	407.04	442.53	425.55	428.70	438.03	474.05	441.94	486.71	462.64	461.71	447.98
	S.D.	41.08	43.61	54.01	58.02	49.62	47.18	48.93	55.83	49.65	52.38	54.63	46.97
Spring	N	3,022	174	884	82	629	39	5,977	510	2,927	221	1,938	170
	Mean	450.91	432.66	473.09	447.65	463.26	452.64	506.30	479.92	522.03	494.77	494.93	482.00
	S.D.	42.85	52.30	54.87	57.89	51.35	46.76	51.38	55.35	52.72	44.65	56.74	49.18
Grade 4													
Fall	N	2,392	114	864	70	619	34	6,452	948	3,172	372	1,955	185
	Mean	439.88	431.33	463.78	451.67	455.56	446.09	506.05	471.35	520.12	499.13	494.21	479.53
	S.D.	43.66	41.25	58.08	59.76	53.10	47.55	55.90	61.25	59.17	62.01	61.92	64.17
Spring	N	2,392	144	864	59	619	20	6,452	510	3,172	189	1,955	120
	Mean	471.23	469.17	492.25	475.27	484.92	480.70	535.51	507.87	548.87	528.95	524.83	507.31
	S.D.	47.01	51.16	62.98	71.37	55.08	53.34	58.11	58.17	59.68	67.69	63.53	56.09
Grade 5													
Fall	N	2,227	112	802	78	587	33	6,810	857	3,603	346	2,205	193
	Mean	465.59	460.78	496.73	474.29	478.14	485.27	535.90	499.51	546.67	527.68	526.24	507.88
	S.D.	47.00	58.19	60.27	75.35	52.34	58.11	59.83	64.25	61.21	69.14	67.01	64.38
Spring	N	2,227	143	802	48	587	14	6,810	466	3,603	167	2,205	107
	Mean	490.79	476.78	520.62	499.60	506.03	472.36	562.54	536.14	576.08	554.03	554.08	539.64
	S.D.	50.36	53.50	65.09	64.09	57.52	58.19	63.93	60.84	64.93	64.66	70.38	71.67
Grade 6													
Fall	N	1,982	85	905	42	620	29	6,891	744	5,805	466	2,515	284
	Mean	489.88	494.36	520.58	510.14	496.88	488.86	567.98	530.54	574.85	549.20	553.21	535.58
	S.D.	50.72	47.49	64.84	86.41	54.01	60.94	64.35	70.20	64.04	66.74	70.57	67.53
Spring	N	1,982	95	905	50	620	24	6,891	380	5,805	270	2,515	90
	Mean	515.89	503.66	547.43	517.34	517.89	512.92	593.89	563.90	598.81	568.07	578.39	566.07
	S.D.	53.26	53.30	67.69	52.67	56.33	65.88	66.99	71.13	67.65	67.64	73.13	75.93

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* The 'Fall or Spring' heading indicates the group with fall scores but no spring scores where fall achievement is described, while it indicates the group with spring scores but no fall scores where spring achievement is described.

Table 1-7

Math Achievement Scores for the First-Year Sample by Availability of the Fall and Spring Scores and Math CE Status

Math CE Status		Title I Students in Title I Schools		Other-CE Students in Title I Schools		CE Students in Other-CE Schools		Non-CE Students in Title I Schools		Non-CE Students in Other-CE Schools		Students in Non-CE Schools	
Availability of Scores*		Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring	Fall and Spring	Fall or Spring
Grade 1													
Fall	N	1,599	165	855	105	329	49	8,440	1,370	3,484	506	2,132	338
	Mean	309.42	307.70	325.67	318.62	325.00	326.82	331.49	321.97	341.32	329.48	330.52	322.66
	S.D.	34.04	33.08	34.57	37.88	35.55	30.77	34.37	35.81	34.22	36.78	37.01	38.58
Spring	N	1,598	166	855	100	329	15	8,440	760	3,484	294	2,132	177
	Mean	370.99	355.04	382.87	377.95	387.46	408.87	394.66	380.03	401.70	384.03	388.95	384.83
	S.D.	43.56	43.69	41.51	44.72	50.95	59.02	44.71	44.12	43.77	41.00	45.08	46.56
Grade 2													
Fall	N	1,686	123	808	99	291	35	7,499	1,137	3,247	410	1,947	255
	Mean	362.51	349.35	386.16	376.43	380.95	385.77	395.22	378.74	406.79	391.80	390.57	380.39
	S.D.	40.26	47.25	45.52	41.98	43.86	50.77	43.97	44.69	43.58	40.99	44.62	42.73
Spring	N	1,686	132	808	76	291	12	7,499	624	3,247	237	1,947	174
	Mean	415.96	403.69	440.14	427.47	435.31	445.17	451.01	431.70	463.84	445.20	443.31	437.45
	S.D.	48.02	47.98	49.70	51.06	55.74	55.59	49.74	51.49	49.49	45.85	52.23	52.33
Grade 3													
Fall	N	1,793	139	768	61	369	36	7,301	1,011	3,189	381	1,942	272
	Mean	407.86	404.36	431.07	419.11	425.95	428.25	447.18	427.20	458.70	440.78	443.12	434.19
	S.D.	43.90	45.37	50.82	49.82	50.94	60.01	47.30	52.82	48.52	52.65	49.14	49.34
Spring	N	1,793	120	768	69	369	22	7,301	585	3,189	232	1,942	166
	Mean	463.22	449.98	485.87	464.17	472.26	487.00	504.42	483.47	519.77	497.47	500.72	490.13
	S.D.	48.52	52.64	57.02	62.99	68.06	67.18	54.44	58.29	56.00	54.06	59.73	57.19
Grade 4													
Fall	N	1,434	92	845	61	373	23	7,395	999	3,415	377	1,954	185
	Mean	445.02	437.45	473.31	454.59	466.96	456.17	499.99	475.49	511.69	497.05	495.77	475.74
	S.D.	48.31	47.88	59.06	67.75	59.27	71.01	57.65	60.78	59.02	58.53	59.10	66.36
Spring	N	1,434	98	845	59	373	11	7,395	562	3,415	196	1,954	119
	Mean	498.40	491.41	518.57	513.07	500.84	504.45	550.40	526.98	563.01	548.74	546.01	525.84
	S.D.	53.97	56.34	66.58	53.96	67.46	30.63	61.62	62.88	64.84	71.09	67.19	60.53
Grade 5													
Fall	N	1,331	66	768	69	400	26	7,729	915	3,787	346	2,203	197
	Mean	486.82	492.47	520.48	512.67	496.63	503.81	543.91	512.90	555.99	534.51	540.03	517.43
	S.D.	52.14	55.74	65.76	67.45	61.48	72.27	61.65	65.50	64.11	65.59	66.39	67.93
Spring	N	1,331	92	768	48	400	10	7,729	517	3,787	169	2,203	105
	Mean	530.66	524.62	558.16	553.90	538.81	481.80	586.79	564.80	603.41	591.20	586.39	569.84
	S.D.	56.87	58.01	71.61	63.61	67.37	60.94	69.94	64.27	73.67	72.06	75.65	78.63
Grade 6													
Fall	N	1,134	57	858	49	457	23	7,774	757	5,960	464	2,495	298
	Mean	526.61	514.40	551.36	532.92	525.32	519.70	585.00	557.68	596.04	571.57	583.88	562.50
	S.D.	57.63	56.72	70.59	86.30	63.38	63.11	67.85	68.81	67.48	72.22	68.25	68.00
Spring	N	1,134	68	858	48	457	19	7,774	419	5,960	277	2,495	91
	Mean	570.63	550.18	590.35	577.40	561.49	581.58	625.35	596.87	635.24	603.48	623.05	613.09
	S.D.	61.40	69.72	76.42	58.09	68.36	84.79	75.41	72.85	77.29	74.43	79.38	82.69

[*] The 'Fall or Spring' heading indicates the group with fall scores but no spring scores where fall achievement is described, while it indicates the group with spring scores but no fall scores where spring achievement is described.

In general, the missing-data group has slightly lower mean scores, but the two groups have comparable standard deviations. The patterns of differences between the groups are similar for all CE categories and for all grades. This information bodes well for the validity of comparisons among students in different CE programs to be presented in subsequent chapters.

Additionally, the rates of missing CTBS scores in the entire first-year sample are presented in Table 1-8 by CE status. For both reading and math scores, rates of complete CTBS data are slightly lower for the non-CE groups than they are for the CE groups. The same finding applied when these missing data rates were examined for different samples (representative, comparison, and nominated) separately. Because there are very large numbers of non-CE students, the greater missing data rates for them still leave us with a sufficient number of cases for the purpose of comparisons among groups.

Family Background. Although data are not presented, we also compared achievement differences between the groups with complete and incomplete CTBS scores within subsamples of students by race/ethnicity (white, black, Spanish heritage, and others), by participation in free or reduced-price meals (a proxy for family economic status), and by mother's educational attainment (college or more, high school graduate, and less than high school; an index related to family educational climate). For each subsample of students with similar background characteristics, a consistent pattern emerges: the groups having incomplete test data have lower mean achievement scores than the groups having complete data.

Exceptions are found only when the number of cases in the former group is very small. These findings agree with those reported in the Compensatory Reading Study (Trisman et al., 1975). Again, the standard deviations (s.d.) for the two groups remain similar and their differences in means are less than .3 population s.d., signifying extensive overlapping of the two distributions.

It is also of interest to note that excluding cases with missing data on student characteristics results in negligible changes of the sample means except when mother's education is involved. Because the teachers were permitted to make a response 'cannot estimate' in the SBC item about parents' education, and such responses were treated as missing data, there is a substantial proportion (about one-third, see Tables A2-5 and A2-6 in Appendix A2) of students for whom information on mother's educational level is lacking. Omissions of these cases from the sample result in an increase of about .1 population s.d. for the mean test scores. This shows that the students whose mother's education is not estimated by their teachers tend to have lower test scores both in fall and in spring. The finding, however, does not have direct implications on the validity of the comparisons performed for this report, because results obtained from analyses involving or not involving the variable of mother's education are similar (see Chapter 2).

The rates of missing CTBS scores were tabulated by racial/ethnic groups, by participation in free or reduced-price meals, and by mother's educational attainment because these characteristics were often included in the analyses. These rates were obtained for the entire sample as well as for the subsamples, separately. The results are presented in Tables A2-1 through A2-6 in Appendix A2. Examination of these tables reveals:

- For both reading and math scores, and in almost all samples, students of Spanish heritage have the highest rates of missing scores, while non-Hispanic whites tend to have the lowest rates.
- Students from families of lower economic status (those participating in free or reduced-price meals) have greater rates of missing scores than others.
- Students whose mothers' educational attainments are lower have higher rates of missing scores than others.

Table 1-8

Percentage of Students With and Without CTBS Reading/Math Scores for Fall and Spring, by Reading/Math CE Status

Grade	Availability of CTBS Scores	Reading by Reading CE Status *							Math by Math CE Status*						
		TI/ TI	OCE/ TI	OCE/ OCE	NCE/ TI	NCE/ OCE	NCE/ NCE	Total	TI/ TI	OCE/ TI	OCE/ OCE	NCE/ TI	NCE/ OCE	NCE/ NCE	Total
1	Fall & Spring	84.1	82.7	82.6	78.4	81.1	81.2	80.5	82.4	80.4	83.7	79.5	81.1	80.5	80.4
	Fall Only	7.2	8.3	9.1	14.5	12.4	12.1	12.1	8.5	9.9	12.5	12.9	11.8	12.8	12.1
	Spring Only	8.6	9.0	7.9	6.9	6.4	6.6	7.2	8.6	9.4	3.8	7.2	6.8	6.7	7.2
	Neither Time	0.2	0.1	0.4	0.2	0.0	0.1	0.1	0.5	0.4	0.0	0.4	0.2	0.1	0.3
	N	3,313	1,194	695	9,111	3,992	2,649	20,954	1,939	1,064	393	10,615	4,294	2,649	20,954
2	Fall & Spring	88.3	83.6	85.9	78.7	83.0	82.0	82.2	86.6	82.0	86.1	80.6	83.1	81.7	82.1
	Fall Only	5.3	8.6	9.3	14.3	10.9	11.0	11.1	6.3	10.1	10.4	12.2	10.5	10.7	10.9
	Spring Only	6.3	7.8	4.6	6.9	6.0	7.0	6.6	6.8	7.7	3.6	6.7	6.1	7.3	6.7
	Neither Time	0.1	0.0	0.2	0.2	0.1	0.0	0.1	0.3	0.2	0.0	0.4	0.3	0.3	0.4
	N	3,438	1,134	820	7,661	3,423	2,384	18,860	1,947	985	338	9,301	3,905	2,384	18,860
3	Fall & Spring	88.9	83.7	86.6	80.5	83.4	81.2	83.1	87.2	85.4	86.4	81.8	83.7	81.4	83.1
	Fall Only	5.8	7.9	7.9	12.4	10.3	11.6	10.3	6.8	6.8	8.4	11.3	10.0	11.4	10.3
	Spring Only	5.1	7.8	5.4	6.9	6.3	7.1	6.5	5.8	7.7	5.2	6.6	6.1	7.0	6.5
	Neither Time	0.1	0.7	0.1	0.2	0.0	0.1	0.1	0.2	0.1	0.0	0.3	0.2	0.3	0.2
	N	3,398	1,056	726	7,422	3,509	2,386	18,497	2,056	899	427	8,921	3,808	2,386	18,497
4	Fall & Spring	90.1	86.7	92.0	81.4	84.9	86.5	84.7	88.2	87.3	91.0	82.3	85.4	86.4	84.5
	Fall Only	4.3	7.0	5.1	12.0	10.0	8.2	9.4	5.7	6.3	5.6	11.1	9.4	8.2	9.5
	Spring Only	5.4	5.9	3.0	6.4	5.1	5.3	5.7	6.0	6.1	2.7	6.3	4.9	5.3	5.7
	Neither Time	0.2	0.3	0.0	0.2	0.1	0.0	0.1	0.1	0.3	0.7	0.3	0.3	0.1	0.3
	N	2,654	996	673	7,927	3,735	2,261	18,246	1,626	968	410	8,983	3,998	2,261	18,246
5	Fall & Spring	89.7	86.2	92.6	83.5	87.5	87.9	86.2	89.1	86.8	91.7	84.1	87.8	87.8	86.2
	Fall Only	4.5	8.4	5.2	10.5	8.4	7.7	8.6	4.4	7.8	6.0	10.0	8.0	7.9	8.6
	Spring Only	5.8	5.2	2.2	5.7	4.1	4.3	5.0	6.2	5.4	2.3	5.6	3.9	4.2	5.0
	Neither Time	0.1	0.2	0.0	0.2	0.0	0.1	0.1	0.3	0.0	0.0	0.3	0.3	0.1	0.2
	N	2,484	930	634	8,152	4,116	2,508	18,824	1,493	885	436	9,188	4,314	2,508	18,824
6	Fall & Spring	91.5	90.4	92.0	85.8	88.7	87.1	87.9	89.9	89.7	91.6	86.6	88.7	86.4	87.7
	Fall Only	3.9	4.2	4.3	9.3	7.1	9.8	7.7	4.5	5.1	4.6	8.4	6.9	10.3	7.7
	Spring Only	4.4	5.0	3.6	4.7	4.1	3.1	4.3	5.4	5.0	3.8	4.7	4.1	3.1	4.3
	Neither Time	0.1	0.4	0.1	0.2	0.0	0.0	0.1	0.2	0.1	0.0	0.4	0.2	0.2	0.3
	N	2,165	1,001	674	8,033	6,541	2,889	21,303	1,261	956	499	8,982	6,716	2,889	21,303

*TI/TI = Title I students in Title I schools, OCE/TI = Other-CE students in Title I schools, OCE/OCE = Other-CE students in Other-CE schools, NCE/TI = Non-CE students in Title I schools, NCE/OCE = Non-CE students in Other-CE schools, and NCE/NCE = Non-CE students in Non-CE schools.

All the above findings point to a summary fact: students most likely to be educationally disadvantaged (poor, minority) are those more likely to be missing critical data for our analyses. However, it was also found earlier that CE students, most of whom are poor and minority, have smaller rates of missing test scores than do non-CE students. This apparent paradox in the data arises because:

- The difference in rates of missing test scores between poor and non-poor, and between white and non-white students are small.
- The correlations between CE status and disadvantaged statuses (i.e., being poor, minority) are not perfect.
- Students who transfer from or into a school during the year are frequently recorded as non-CE students even if they have received the services before or after transferring. These same students also miss some tests and therefore contribute to the increased rates of missing achievement scores for non-CE students.

Missing Data by School's Demographic Characteristics

As there is little evidence in our results showing differential CE effects according to geographic region or urbanism of the schools (see Chapter 2), we have not presented data concerning the rates of missing test scores by these demographic dimensions. However, the reader may refer to the special report on attrition (Zagorski et al., 1981) for some information in this regard. The joint relationships of various factors (e.g., achievement status, CE status, race/ethnicity, etc.) with attrition were also explored there, but the findings do not lend themselves to easy or clear interpretations.

Missing Data for Teacher-Level Measures

Another kind of missing data, especially in the regression analyses to be reported in Chapters 6 through 8, is the missing teacher-level data. These missing data arise as a result of non-responses of the teachers and/or lack of information to link the students to their teachers. This problem, and the substantial amount of missing data for mother's education can reduce the sample for analysis to about 55 to 60 percent of its original size where both teacher-level information and student characteristics are required. In these cases, the relationships between student-level variables tend to remain similar to those obtained in the analyses that employ a larger sample by including students without teacher-level data but with the required student-level data. Hence, the loss of information because of incomplete teacher-level data is not expected to pose a serious threat to the validity of the findings.

Summary and Conclusions

The differential rates of missing test scores for groups of students with different characteristics, while modest, can bias the descriptions of achievement levels for the sample because these characteristics and achievements are correlated. Furthermore, within subsamples of students, the missing scores were consistently associated with students who obtained slightly lower scores on other test occasions (and thus with lower achievement, considering the high correlations between test scores). This characteristic of missing data can also introduce positive biases to the estimates of achievement levels for the entire sample as well as for the subsamples. However, comparison of the statistics for the complete-data group in the representative sample (Tables 1-2 and 1-3) with those projected for the population (Table 1-12 of Report 9) based on all cases having scores at the test administration suggests that such biases are negligible.

It is important to remark that the emphasis of this report is on comparisons between groups rather than on descriptions. In this context, the concern is how the missing data will affect the validity of the comparisons. If one expects students of higher achievement and from more advantaged homes to have greater growth rates, the loss of information because of missing data will also be expected to bias the estimates of achievement growth. However, because the characteristics of missing data are not substantially different among the analysis groups and the missing data rates are moderate, their effects on comparative analyses are not likely to be serious. More important, most of our analyses explicitly use student characteristics (including initial achievement) to adjust for background differences. Consequently, the effects of differential losses of information by student characteristics are mitigated and the results are not expected to be compromised.

ANALYTIC APPROACHES

This section presents a discussion of the strategy taken in the analyses for this report, and summarily addresses a few specific analysis issues pertaining to the entire report. The rationale for each particular approach will, however, be given in the chapter where the results of that approach are reported.

General Approach

Over the years, as each report of the evaluation of compensatory programs was issued, it was criticized on the analytic techniques used. These criticisms, while sometimes blurring the significance of the findings, served to encourage analysts to develop additional methods that would address the problems. Many of the difficulties in a survey-evaluation study arise because randomization cannot be achieved. Consequently, there is no guarantee that a comparison group can be obtained to approximate closely the *unknown* true state of affairs in the absence of the additional, compensatory services. A useful strategy under this circumstance is to resort to multiple techniques for analysis. Each analytic method allows different assumptions and addresses different methodological issues. If the findings with different methods are similar, the analyses are robust with respect to a variety of assumptions. By synthesizing the results of a set of mutually complementary analyses, we hope to reach some generalizable conclusions that are applicable to different conditions, and thereby increase our confidence in the evaluation.

Following Tukey's (1962; 1969) advice concerning exploratory data analysis, we have first plowed through the data descriptively to examine potential threats to the validity of the planned analyses. The threats may arise from unreliabilities of measures, differential growth rates among groups being compared, selection biases, and differential attrition that could enhance selection biases, etc. Awareness of these potential problems can guide us to make proper conclusions by considering the possible effects of biases. Another advantage of a thorough understanding of the data gleaned from these descriptive analyses is that many insights into good explanations of the findings in the inferential analyses are offered. We then employed multiple statistical analyses and estimation methods to determine a reasonable range of the effects of CE by sorting out the many confounding factors that operate concurrently to influence educational development.

The major problem of evaluating CE effects is that we are necessarily dealing with comparisons among groups having large preexisting differences. The seriousness of this problem has been pointed out most emphatically in Lord's (1967) paper that concludes, ". . . there simply is no logical or statistical procedure that can be counted on to make proper allowances for uncontrolled preexisting differences between groups." This statement has encouraged many methodologists to search for better techniques. Some progress has been made, but researchers have mostly concurred in Lord's opinion (e.g., Cochran and Rubin, 1973).

The recurrent recommendation in the literature now is to use multiple analysis strategies, accompanied with careful appraisal of the validity of the findings from the different analyses and the plausibility of rival explanations (e.g., Reichardt, 1979). This kind of tactic has been successfully practiced by Cook and his colleagues in their assessment of the effects of viewing 'Sesame Street' on children's cognitive development (Cook, Appleton, Conner, Shaffer, Tamkin, and Weber, 1975). In the present report, we have adopted many different comparison methods that have different likelihoods of showing an effect. The results are then integrated, with consideration of the implications of each of the findings and their interrelationships, to provide summary answers to the research questions.

Taking this strategy, while it has the advantage that the conclusions are likely to be more convincing, results in a profusion of analyses that may leave the reader in a state of confusion. Awareness of this problem has led us to place many of the results of analyses in the appendices, so that we can stress the convergences and those analyses in which we have the greatest confidence. The more technically trained reader will, of course, want to examine the results in more detail in order to understand better the strengths and weaknesses of the methods. The appendices are intended to serve the interest of this latter group of readers.

Some Specific Analytic Issues

Level of Analysis. The primary level of analysis for this report is the student. The importance of choosing an appropriate level of analysis in educational research has been recently noted in a series of discussions (e.g., Burstein and Knapp, 1975; Glendening, 1978; Cronbach, 1976). A general caution is that the appropriate level of analysis depends on how the finding is to be applied. In this report, the main interest lies in assessing the effects of CE on the cognitive growth of the students individually. Some will argue that classroom instruction has a collective effect and therefore the instructional group is the proper level of analysis. Yet, some will even argue that the school is the level of interest because the CE program is principally implemented in the school context. Additionally, there are problems such as the level at which the data are observed and if there are heterogeneous within-class and within-school effects. To address these issues, one would have to resort to techniques for multi-level data analysis (e.g., Burstein, Linn, and Capell, 1978).

Because the immediate purpose of this report is to address the effectiveness of CE in improving achievement, and because important data (selection for CE, test scores, and amount of services received, specifically) have been obtained for individual students, we have performed the analyses at the student level. In multi-level analyses, dummy grouping variables are commonly used to represent group-level effects. The shortcoming of such a practice is that the results do not afford clear and substantive interpretations (Burstein, 1980). Instead of dummy variables, we choose to include group-level variables that have substantive meanings in some analyses, so that the findings can be interpreted easily. Specifically, the analyses to be presented in the second part of this report employ both teacher-level and school-level data (those obtained by aggregation as well as those collected directly for the schools) in the student-level model. By doing so, the contextual and higher-level (teachers and schools) effects can be assessed explicitly. This kind of analysis can best be described as student-level analysis with mixed-level data.

A concern of the student-level analysis is that the student is not the primary sampling unit. Instead, schools were selected randomly within the sampling strata and all students in the schools were included in the data collection. Because a probability sample of students was not obtained, the question arises whether weighted data analysis should replace the usual unweighted analysis. Our decision is to analyze the data in an unweighted manner, as exact representation of the groups is not essential for comparison among groups. What is essential is that students in each group to be compared adequately represent that group. The large sample sizes and the stratified sampling scheme used to include students in the study augur well for the adequacy of the data. However, it is recognized that standard errors of mean differences between subgroups that cut across the strata and clusters in the sampling design can be underestimated when they are computed as if the sample were random. The comparisons of means between students in different compensatory programs can thus be biased. Similar biases can also be expected in the regression and structural relation analyses. At the present, satisfactory solutions to these problems have not been devised (Kish and Frankel, 1974).

The Problem of Non-Equivalent Control Groups. In our analyses we have resisted the temptation to re-sample in an attempt to match comparison groups on an *ad hoc* basis. Simple matching methods are generally held to be inappropriate because of serious regression artifacts. Advanced multivariate matching techniques have been proposed that overcome some shortcomings inherent in univariate methods, but they are very time-consuming and costly to implement, and have uncertain benefits (Sherwood, Morris, and Sherwood, 1975; Rubin, 1976a, 1976b). Instead, we employ blocking and covariates in efforts to control for preexisting differences, and in some cases the covariates are adjusted for unreliability.

Analysis of Subtest Scores. Our analyses have been restricted to univariate analysis with respect to the outcome (dependent) variables. In particular, the achievement scores for reading and math are analyzed separately, because the selection for CE, the data on instructional services, and program characteristics have all been recorded in each of the skill areas separately. This practice underscores the primary interest to evaluate the effectiveness of CE in raising student achievement levels in the subject for which compensatory services are provided. In general, reading and math achievements may influence one another in light of the substantial correlations between them. Thus, there is an interest to study the interactions between the effects of reading and math CE. Such interactions, if they exist, will support the policy to integrate CE programs for different subjects. However, the current one-year evaluation is not adequate for investigating the inter-subject influence, because the interactions would have delayed effects. The present report will therefore concentrate on separate analyses for reading and math. The relationships between the effects of different CE programs can best be studied over a longer time interval.

In the past, there was some interest in examining CE effects on the subskill areas (vocabulary and comprehension for reading; concepts and computation for math) separately. This interest is promoted by a belief that CE can be effective in improving comprehension or computation but not vocabulary or concepts because learning of the latter subskills may be greatly related to family background and out-of-school environment (see Technical Report 4). To address this issue, Coulson and his colleagues have analyzed scores in these subskill areas separately and have occasionally found some different results (Coulson, Ozenne, Van Gelder, Inuzuka, Bradford, and Doherty, 1975). But the evidence for differential effectiveness was mostly tenuous and inconsistent, so that analyses of subskill scores were discontinued in the later years of the study (Coulson, Ozenne, Doherty, Duck, Hemenway, and Van Gelder, 1976).

Considering the results of Coulson et al., and the lack of specific information about teacher's emphases on different subskills, we do not expect the analyses of subskill scores to be fruitful. Moreover, problems associated with the small number of items for some subtests could undermine the validity of the findings because of low reliabilities and inadequate interlevel articulations (see Technical Report 9). We therefore do not analyze subskill scores. In passing, it may also be noted that multivariate analyses of the component scores for each skill could have been performed, but the results would have been difficult to interpret in light of the high correlations between the subtest scores (see Report 9).

The Problem of Specification Errors. Last, we must address the issue of specification error in the analyses. By this we mean that the analyses can be held in question because they do not include some variables that could have a direct or indirect effect. We have attempted to use every available variable that we anticipated would have affected the results. The alternative strategy of throwing all conceivable variables into every analysis, in addition to being very costly, could introduce unstable parameter estimations and uninterpretably complicated findings. Often, we consulted results of previous studies and of our preliminary analyses and decided to omit some variables from the analyses.

In reality, no analysis can consider every variable that every person deems critical to an accurate understanding of the findings. We heartily concur with Cooley (1978) that, "some degree of specification error will always be with us, but we are more likely to have a cumulatively improved understanding of educational processes if we are guided by more and more adequately specified models . . . ." To this end, we believe we have obtained as many critical variables as we could in the immense data-collection efforts and have selected almost all the relevant variables for inclusion in each specific analysis.

In connection with the issue of specification errors, we should note that we have not obtained a measure of the degree of curriculum overlap with the contents of the CTBS tests, and therefore have not been able to incorporate it into the analyses. Recent studies (The National Institute of Education, 1977; Cooley and Leinhardt, 1978) have suggested that this measure, as a component index of the opportunity factor, is quite useful in explaining the variance of the posttest achievement scores. To the extent this finding applies to the context of the present study, some analyses in this report could be expected to suffer from specification errors. However, we have incorporated another major component (time) of the opportunity factor into the analyses. In addition, the unique practice of using 'recommended level' scores (see earlier discussion in this chapter) for analyses in this study may reduce some of the biases introduced by the omission of a 'curriculum overlap' measure. The posttest level that gives a better distribution of scores for the students in a given grade within each school probably covers the curriculum content more adequately than does the other test level. If there is little overlap between the test content and what is being taught during the test interval, one may expect the score distributions to exhibit floor (have never been learned) or even ceiling (have been learned in previous years) effects.

Finally, we remark that the Sustaining Effects Study is intended to evaluate the effects of educational practices in a general way as measured by tests that do not unduly reflect any specific curriculum. In a broad perspective that emphasizes improvement of generalized performance, the effectiveness of the nation's CE programs can perhaps be better assessed without deliberate consideration of the curriculum issue. Nevertheless, we agree that in some other cases the curriculum issue is important. With regard to this issue, the Substudy of Successful Practices in High-Poverty Schools has obtained a measure of curriculum overlap with test content (for grades 2 and 5 in 55 schools during the 1978-79 school year), and will examine the effects of curriculum content on achievement scores in a later report (Technical Report 16).

SUMMARY

In this chapter, we present some background information to facilitate the reading of this report. We review briefly the history of evaluating compensatory-education programs, especially of the Title I program, that leads to the Sustaining Effects Study. The study is designed to overcome the difficulties in previous evaluations so as to provide a better picture of the current state of the programs. It has a nationally representative sample of schools and follows the educational experiences and achievement progress of the same students for three years. As a result, the long-term effects of compensatory services and the relationships between achievement growth and the educational process can be examined thoroughly. These evaluation efforts begin with this report that analyzes the data collected during the first year of the study (the 1976-77 school year).

This report examines student achievement growth during the school period in order to provide a baseline reference for assessing the growth between school years (over the summer period). The general approaches and a few specific issues concerning analysis strategies are discussed to inform the reader of what to expect in the report. In essence, we employ multiple approaches to analyze the data and then synthesize the findings from mutually complementary analyses (which are based on various assumptions) to obtain an overall evaluation of the programs.

Because the problem of data attrition is a common concern in all of our analyses, we address it in this chapter to prepare the reader for a better understanding of the results presented in subsequent chapters. As achievement scores constitute the most critical data in this report, the analyses of data attrition focus on the rates of missing test scores and their relationship with student characteristics. In order to assess how differential rates of missing data among analysis groups may affect the validity of the analyses, we also compare the distribution of test scores among students who supply different amounts of data.

For the first school year of the study, we find that, combining all six grades, 9.4 percent of the students have only pretest scores, while 8.4 percent have only posttest scores. About 82 percent of the students are present in both the pretest and posttest administrations. Among students of different backgrounds, the analyses show: (1) by race/ethnicity, students of Spanish heritage tend to have the highest rate of missing test scores, while non-Hispanic whites tend to have the lowest rates;

and (2) with respect to economic status, students from low-income families generally have greater rates of missing scores than others. Furthermore, students who miss scores in one test administration on the average achieve lower scores on the other test occasion than those who have test scores for both administrations; the mean difference is usually less than .3 standard deviation of the score distribution in the population. The within-group standard deviations are very similar between the two groups, suggesting an extensive overlap between the distributions of scores.

It is tempting to conclude from these results that the loss of information because of non-random missing data biases or invalidates the analyses to be presented in the remaining chapters. However, it should be remembered that student backgrounds have been explicitly considered in the evaluation to control for preexisting differences among students. In this way, we expect the moderate amount of missing data and the small association between data attrition and student characteristics to have little influence on the validity of our findings.

PART I

THE EFFECTS OF COMPENSATORY EDUCATION AND INSTRUCTIONAL SERVICES

INTRODUCTION TO PART I

The first part of this report contains four chapters, addressing the effects of compensatory services and the factors that influence such effects. In Chapter 2, we examine the achievement pattern of students who do and do not receive compensatory services, and compare the achievement growth of compensatory-education (CE) students with various expectations for them in the absence of compensatory services in order to assess the effects of such services. In addition to achievement in reading, math, and practical skills, we also examine the students' development of attitudes toward learning and school. It is concluded that compensatory services generally have positive impacts on basic-skill achievement, particularly in math, and therefore are helpful in arresting the anticipated gap widening between the achievement of disadvantaged and non-disadvantaged students.

In order to understand how the effects of CE are brought about, Chapter 3 investigates the role of one of the most important aspects of compensatory programs—instructional services—in the achievement process. We find that the relationship between the amount of total instruction (measured by number of hours) and achievement growth tends to be positive, but quite small. As CE students tend to receive more instruction than non-CE students by special teaching staff and in small groups, we further distinguish the instructional services into three kinds: regular instruction that is provided by classroom teachers in groups of seven students or more; special instruction that is provided by special teachers, aides, and assistants, or by regular teachers in groups of six students or less; and independent work with study materials or tutors. The differential effects of these three kinds of instruction (regular, special, and tutor/independent) are examined to determine which kind has greater effects. The analysis reveals little evidence for positive effects of special instruction, so we conclude that such instruction can not explain the positive impacts of CE demonstrated in Chapter 2.

Although the analysis uncovers only a tenuous relationship between achievement growth and total instructional time, we remain hopeful that when the amount and intensity of effort are sufficiently increased, the achievement gap suffered by CE students can be narrowed appreciably. In Chapter 4, we focus our investigation on the issue of a 'critical level of effort' that is required to result in a meaningful reduction of the gap. For this purpose, the achievement growth of CE students is related to the level of instructional effort which is measured by the resource-cost to reflect both the time and labor-intensity of the services. For the most part, we are unable to determine such a critical level of effort, but the analysis provides extra information on the relationships between achievement and instructional effort.

Finally, we turn our attention to two non-instructional factors that are considered likely to have influences on the effects of CE. Two questions are addressed in Chapter 5: (1) What is the best time to provide compensatory services? and (2) Are the effects of compensatory services related to student history of participation in the programs? The results of our analyses support the belief that compensatory services can be more effective when provided at the earlier grades. With regard to participation history, the analysis concludes that there is not a simple answer to the question whether repeated participation can enhance or suppress the immediate effects of compensatory services.

To inform the reader of what to expect in these chapters, we present some highlights of the findings below:

- There are positive, but small, effects of compensatory services on reading and math achievement of the participants. In reading, the positive effects are primarily shown in the first three grades and in grade 6; whereas in math the effects are positive in all grades, but of different magnitudes. These positive effects are noticeable particularly for students who receive the services that are funded at least in part by Title I, while it is difficult to demonstrate similar effects for students who receive compensatory services that are exclusively funded by non-Title I sources.

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- With respect to practical achievement and attitudinal development, there is little evidence of substantial effects of compensatory programs, most likely explainable by the inadequacy of the instruments used to measure them.

- On the whole, amount of total instruction has a positive but very small relationship with achievement growth. When the effects of different kinds of instruction are examined, there is some evidence for positive effects of regular instruction and independent work; special instruction (which is mostly provided to CE students), however, generally fails to show positive effects on achievement. Because CE students tend to receive more special instruction and less regular instruction (with a total usually more than that received by non-CE students), it is concluded that the positive effects of compensatory services, when shown, are not likely to be attributable to the special instruction received by the students.

- There is tenuous evidence that a positive relationship between achievement growth and instructional effort exists throughout the range of efforts commonly observed in the current programs of compensatory education. Based on the results of Chapter 4, it is concluded that there is still not enough evidence to support the concept of a 'critical level' of instructional effort required to effect a meaningful narrowing of the expected achievement gap between CE and regular students.

- On the basis of the cross-sectional analysis, it is found that, under current implementation, CE benefits its participants relatively more at the earlier grades, particularly in reading. The relatively greater effects at the early grades are not accompanied by relatively greater efforts. These results suggest that earlier remedy delivered in time is more efficient.

- The nature of the effects of repeating participation in the program remains unclear. At some grades, it appears that students who have participated for two years gain more in the current year than the new participants. At others, the results appear to be opposite. The inconsistent findings across grades may arise in part because we do not consider the entire history of participation (data are not available); such history tends to be more complicated in the upper grades.

CHAPTER 2. EDUCATIONAL DEVELOPMENT OF COMPENSATORY EDUCATION STUDENTS DURING THE SCHOOL YEAR

The achievement patterns in reading, math, and practical skills, and the development of student's attitude toward learning and school were examined for CE and non-CE students. Five evaluation designs were employed to assess the effects of CE by comparing the achievement of CE students with various expectations for them in the absence of CE services. The results indicate that CE has been generally effective in accelerating reading and math achievement growth of its participants, and is thus helpful in reducing the anticipated gap between CE students and their educationally non-deprived peers. However, the effects of CE are not large enough to bring the achievement levels of the educationally deprived children up to par with the non-deprived ones. The positive effects of CE are more commonly observed in math than in reading. In reading, CE was primarily effective in the first three grades; whereas in math, it was shown to be more or less effective in all grades. These effects were noticeable particularly for students who received CE services that were funded at least in part by Title I. By comparison, it was difficult to demonstrate positive effects of other CE services that were exclusively funded by non-Title I sources, probably because these services need not directly aim at improving basic skills.

With respect to practical achievement and attitudinal development, there is little evidence to show substantial effects of CE. For the most part, the results are inconsistent across grades. The lack of interesting findings in these two areas may be attributed partially to the limitation of the single-level Practical Achievement Scale, and to the questionable validity and reliability of the Student Affective Measures, respectively.

One of the primary goals of Compensatory Education (CE) is to accelerate the educational development of disadvantaged students. In this chapter, the educational development of CE students is examined to determine the extent to which the goal was achieved. As remarked earlier, our decision to perform this traditional fall-to-spring evaluation stems from the conviction that it is an essential component of a complete long-term evaluation.

Fall-to-Spring Period for Evaluation. On the basis of their analyses using data from states and districts, David and Pelavin (1978) recommend that evaluations cover the summer months. Accordingly, they advise school evaluators to choose either the fall-to-fall or spring-to-spring period if only two testings are intended. Although an evaluation that includes the summer months in the pretest-posttest interval might provide a better index for long-term effects, because it considers summer losses or gains, it also confuses the issue by introducing a time period of academic experience that is less intense, highly variable, and difficult to assess.

Summer recess is a long-standing educational policy, initially releasing children for farm work but later justified as being necessary for noncognitive development. Children's summer environments vary widely in their provision of educational stimulation: from a climate that promotes forgetting and the need for readjustment to school in the fall, to one that offers opportunities to assimilate, apply, and consolidate what has been learned, or to learn new skills. These variations depend on an array of socioeconomic factors and family values that are not easily influenced by educational policies. Therefore, we can understand the effects of education only by separately examining the course of development from fall to spring and from spring to the next fall.

With evaluations performed over each of the time periods, one may find that CE has been effective during the school year in improving the achievement of participants, but the effects have not been carried over to the next fall. In such a case, CE effects might be maintained between school years by summer CE programs, if there were evidence showing the effectiveness of such programs in suppressing the loss. There have been some controversies over the issue of summer loss. Some recent studies (Thomas and Pelavin, 1976; Pelavin and David, 1977) appeared to support the view that there is an absolute loss in achievement for disadvantaged students over the summer. However, the data were of questionable quality and appeared not to be nationally representative. Because the quality of data collected in the SES is superior to any of the data previously employed for investigating this issue (see Chapter 1), a separate report (Technical Report 8) has been devoted to the assessment of the pattern of students' changes in achievement over the summer months and the evaluation of summer schools. Additionally, results of longitudinal studies addressing this same issue across more than one year will be presented in Technical Report 15.

Meanwhile, we have completed the one-year fall-to-spring analyses in order to provide a preview of the first-year results and to offer a thorough evaluation of CE effects during the school year. Results obtained with various approaches will also supply valuable information for selection of appropriate models and techniques to be employed in the multi-year longitudinal study.

Criteria for Evaluation. The goal to raise the achievement levels of disadvantaged students through compensatory services is deliberately rather vague. A standard has never been set nationally for judging whether the goal has been met. Because this is a national evaluation, it is necessary for us to define criteria for judging goal attainment at the national level. To what extent the goal is reached depends on our expectations. One can make the goal a very ambitious one, such that it probably will never be met. For example, there was an optimistic view early on that Title I could help raise the achievement of participants to the level of their non-disadvantaged peers, and in such a way that it would be maintained at that level thereafter with regular educational services. Between 1965 and 1976, evaluations have dashed that view by showing that CE students stay about as far behind their peers at the end of instruction as at the beginning (McLaughlin, 1977). These results led many to reduce their expectations so that CE would be considered helpful if participants don't fall behind as fast as if there were no CE.

The anticipated use of the results also influences one's strategy in evaluation. In summative evaluation (Scriven, 1967), one seeks to make decisions on whether the process is to be further supported. Formative evaluation, on the other hand, aims at recommendations for improving the process. According to this distinction, formative evaluation is appropriate as the objective of this study. Knowledge of how well we have achieved along the continuum of goal attainment will assist policy makers in setting future goals realistically and in finding modifications of the efforts so as to make greater expectations reachable. For this purpose, the educational development of CE students will be described and compared with a variety of criteria. By summarizing the results of the different comparisons, we hope to gain a clear picture of the effectiveness of the nation's CE programs.

The comparisons used to assess the effects of CE should reflect a range of reasonable expectations for the participants' progress. These expectations can be formed on the basis of our knowledge about the likely situation assuming no CE services. If experiments with random assignment had been feasible, we could have obtained such information from the control group. Unfortunately nearly all evaluations of social programs depend on observational and survey data from intact, not randomly constructed groups. The problems that threaten the conclusions drawn from these kinds of studies have been extensively discussed (e.g., Campbell and Stanley, 1966; Lord, 1967; Cochran, 1969; Campbell and Erlebacher, 1970; Campbell, 1974; Campbell and Boruch, 1975). Advances in estimating program effects based on designs with non-equivalent control groups and in improving inferences from such data have been offered by methodologists (e.g., Goldberger, 1972; Cochran and Rubin, 1973; Rubin, 1973a, 1973b; Kenny, 1975; Bryk and Weisberg, 1976; Cronbach, Rogosa, Floden, and Prince, 1976; Rindskopf and Wolins, 1976; Roskam, 1976; Bryk and Weisberg, 1977; Linn and Slinde, 1977; Linn and Werts, 1977; Magidson, 1977; Overall and Woodward, 1977a, 1977b; Rubin, 1977; Barnow, Cain, and Goldberger, 1978; Reichardt, 1979; Bryk, Strenio, and Weisberg, 1980).

Drawing ideas from the literature and carefully considering the unique features of our data base, we elected to employ norm-referenced standards as well as criteria derived from comparison groups to gauge the effectiveness of CE. As Stake (1967) pointed out, there are two types of comparisons —

absolute and relative. Both types of comparisons may well be employed in a comprehensive evaluation. In reality, few absolute comparisons are fruitful except in the evaluation of instructional programs specifically designed for mastery learning. No meaningful absolute standard can be set in the present context unless in reference to past findings. This is not just because of the use of standardized achievement tests as the chief measurement tools, but also because the goal of CE is intrinsically a relative one. The idea of providing CE to help disadvantaged students originated from findings summarized in reports like Coleman's (Coleman, Campbell, Hobson, McPartland, Mood, Weinfeld, and York, 1966; see also Mosteller and Moynihan, 1972), which suggested that if left unassisted, the achievement gap between disadvantaged and non-disadvantaged students tends to widen with the years. Compensatory services are devised to close that gap by raising the achievement levels of the disadvantaged. Consequently, the accomplishment of CE can be more appropriately judged relative to the anticipated state of affairs than against an absolute standard.

In fact, the distinction between the two kinds of comparisons is not unambiguous. For instance, one may argue that the old Title I standard of one grade-equivalent (GE) month of progress for one month of instruction is an absolute one. However, it could be regarded as a relative one in terms of its reference to the GE scale. Since the calibration of a GE scale depends on a norm population, such a standard implies a relative comparison. By this line of reasoning, the analyses we performed focus on relative comparisons. The norm-referenced criteria are set on the basis of the norms established with the first-year SES data collected in the representative schools (Hemenway et al., 1978).

Other criteria are derived using data from non-CE students, either by forming different comparison groups or by statistical modeling. The purposively selected comparison schools, which have high poverty concentrations but do not receive CE funds, enlarged the data base so that comparison groups as similar as possible to the CE students could be assembled. Additionally, student background information and pretest scores make it possible to search for statistical models that adequately estimate the posttest performance for subgroups of non-CE students. The estimated performances of a group of non-CE students who are similar to the CE students then serve as a basis for comparisons.

Outcome Measures. The primary outcome measures in the SES are achievement scores on the Comprehensive Tests of Basic Skills (CTBS). Although the basic skills of reading and math are essential for modern life, and CE is ultimately aimed at improving the futures of its participants' lives, the use of standardized achievement tests alone could be inadequate for assessing skill development. These tests are considered by some to be biased against minorities and the poor. In addition, the test content may not be relevant to some skills required in real life. To alleviate the concern about test biases, both the reading and math subtests of the CTBS were carefully screened to remove possibly biased items. Regarding the content, a Practical Achievement Scale (PAS) was administered to students in grades 4 through 6 to supplement the reading and math data. The PAS measures functional literacy and math skills required in coping with daily life. In this chapter, data obtained with the PAS are also analyzed in order to assess the effects of CE on the development of practical skills.

A third measure to be examined is the Student Affective Measure (SAM). Improving student attitudes toward learning and school has been an objective of Title I, partly because many educators believe that there is a relationship between attitude and achievement. There have been inconsistent findings about this relationship: positive relations were found by Coles and Chalupsky (1976) and by Shavelson, Hubner, and Stanton (1976), but negative ones were obtained in the Compensatory Reading Study (Trismen et al., 1975) and the present study (Hemenway et al., 1978). Despite this controversy, the attitudinal aspect of educational development is not to be ignored, because the cultivation of a positive attitude can enrich the learning experience, and that in itself may be an important objective for CE. The results from the analyses of the Student Affective Measures (SAM) are presented in the last section of this chapter.

READING AND MATH ACHIEVEMENT — ARE CE STUDENTS CATCHING UP WITH THEIR PEERS?

Because assessment of impact in the basic skills is the principal charge of this study, we devote most of our effort to it. The aim is to determine whether CE students make greater progress than anticipated, such that at the end of the school year they are closer in achievement to their non-disadvantaged peers than they would be if CE had not been provided. For this purpose, the analyses will assess the achievement growth of CE students relative to a range of expectations, without considering the underlying mechanisms that effect the growth. This missing link will be addressed by the analyses presented later in this report.

Evaluation Designs. Five types of evaluation models are employed that are related to the models required by the Education Department for use by grantees in evaluating and reporting on their local Title I projects (Tallmadge and Wood, 1976). The large SES samples provide us a unique opportunity to apply a variety of methods that require different subsets of data to address the same question. Briefly, the norm-referenced analyses are variations of Model A (norm-referenced design). The analyses of variance (ANOVA) with different layouts and different measures of growth, and the analyses of covariance (ANCOVA) using different analysis groups and adjusted for unreliabilities of the covariate (pretest score) are designed to address the cases of Model B (control-group design). The comparison of gains conditional on pretest scores is a deviation of Model C (special regression design). Additionally, the comparisons with expected growth represent a blend of Models B and C where regression-based prediction models are employed to mimic the performance of a control group that is like the treatment group in pretest scores and other relevant characteristics. The relationship between our five models and the commonly used Title I project models are illustrated in Figure 2-1.

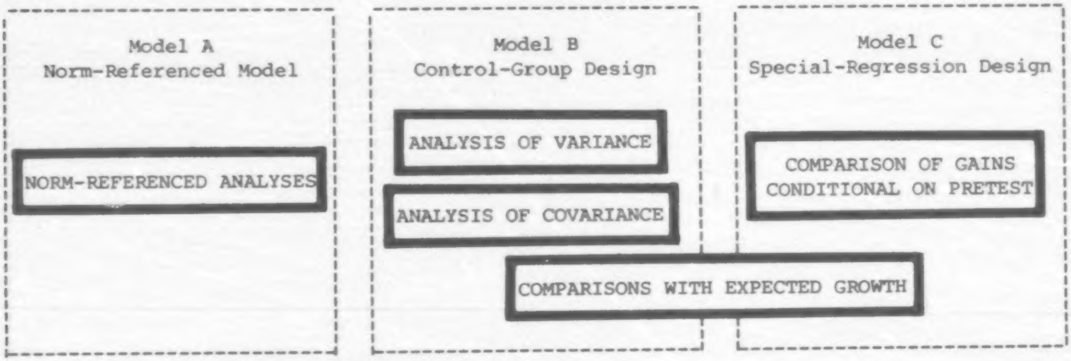

Figure 2-1

Relations of the Five Evaluation Designs of This Chapter to Evaluation and Reporting Models for Local Title I Projects

The analysis of each design further encompasses a class of subanalyses. All the analyses are devised to complement one another so that pitfalls in one may be avoided in another. In the end, we hope that the integrated findings from these different approaches will approximate an accurate evaluation.

The Metric of the CTBS Scores. As new norms have been established empirically, based on data collected in both fall and spring, the expected posttest achievement derived from the norms can be directly expressed in terms of the standardized normal score (z-score) associated with a percentile rank. Additionally, the vertical scale score (VSS) created specifically for this study measures achievement on a continuous scale across test levels and can be directly and meaningfully used for the determination of gains over time. For this reason, the analyses described in this section were performed either with z-scores or with VSSs.

Groups of Students to be Compared. As noted in Chapter 1, reading and math achievement are examined separately, each employing CE status for the respective subject. A number of student groups are defined, separately for reading and math, in terms of their CE status and/or other characteristics. We use the groups that will provide the sharpest comparison consistent with each analysis design. The six groups commonly used in the SES are explained below:

- *Title I students in Title I schools:* students selected for Title I and possibly also other-CE in schools that receive Title I funds either alone or in combination with other-CE funds.
- *Other-CE students in Title I schools:* students selected for only other-CE in schools that receive Title I as well as other-CE funds.
- *Other-CE students in other-CE schools:* students selected for CE in schools that receive only other-CE funds.
- *Non-CE students in Title I schools:* students not selected for any CE in schools that receive Title I funds either alone or in combination with other-CE funds.
- *Non-CE students in other-CE schools:* students not selected for CE in schools that receive only other-CE funds.
- *Non-CE students in non-CE schools:* all students in schools that do not receive any CE funds.

In the definition of the six CE groups, selection for CE is considered separately for reading and math, but the characteristic of schools depends only on receipt of CE funds, disregarding whether they are spent in reading or math or both. When we want to differentiate CE schools on the basis of subject emphasis, the last three groups are recombined into two according to the existence of CE programs in the subject. This distinction is motivated by the desire to account for possible spillover CE effects within the school and differences in school's need for CE in the subject. Many of the analyses to be presented adopt this distinction. The two newly created groups of non-CE students in reading are:

- *(Reading) non-CE students in (reading) CE schools:* students not selected for (reading) CE, but attending schools that offer (reading) CE in at least one grade.
- *(Reading) non-CE students in (reading) non-CE schools:* students not selected for (reading) CE and attending schools that do not offer (reading) CE to any students in the school.

Parallel groups of non-CE students in math are obtained for math analyses. It would be helpful for the reader to remember this subject-specific definition of schools when only CE and non-CE categories are used to distinguish the schools.

When we want to make especially sharp comparisons between CE students and non-CE students who are as similar as possible to one another, a subset is picked from each of the preceding two groups of non-CE students. The two new comparison groups are made similar to the groups of CE students with respect to their need for special services, because only those non-CE students who are judged to need CE are included. These two restricted subgroups (again, subject-specific) are:

- *Needy non-CE students in CE schools:* non-CE students in CE schools who are judged by their teachers to have need for CE in the subject area.
- *Needy non-CE students in non-CE schools:* non-CE students in non-CE schools who are judged by their teachers to have need for CE in the subject area.

There are several reasons for choosing these two comparison groups of non-CE students based on their judged need for CE. *First,* teachers' judgments of need for CE frequently play an important role in selecting CE participants (see Report 5). Teachers acquire intimate knowledge of their students' performances and are likely able to make judgments of each student's need for compensatory assistance that complement and adjust information provided by achievement tests. It may also be recalled that in earlier years of Title I, eligibility was frequently tied to some kind of teacher judgment. For instance, the identification of eligible students in the 1968-69 national survey relied on teacher estimates of whether a child had the ability to complete high school. *Second,* teacher judgment of need for CE was found to be closely associated with pretest achievement status. Specifically, a cutoff near the 35th percentile maximizes the agreement between judged need and the dichotomy of achievement status defined by the cutoff (see Report 13). *Third,* a large proportion of CE students was judged to be in need of CE by their teachers, and achieved at low percentiles.

We therefore consider teacher's judgment of CE need as a proper and valuable indicator of educational disadvantage. The descriptive analyses for this report reveal that the average pretest scores for these two comparison groups are quite similar to those for CE students, and Title I students in particular (see Figures 2-4 and 2-5). The comparability of average pretest scores between the CE groups and the comparison groups reduces the potential biases in many of the models used to analyze data from an observational study.

In forming the analysis groups, we did not distinguish between study samples (representative, comparison, and nominated). Thus, CE students from the nominated schools were combined with those from the representative schools in the assessment of the effects of CE. The advantage of mixing CE students from these two samples is that wider program variations would be involved than otherwise. However, because the nominated schools are selected purposively on the basis of promising innovations in the schools' programs, it has prompted some to think that this practice might introduce a positive bias to the estimates of the overall effects of CE. In order to clear such a suspicion, we separately examined the achievement growth of the CE students in the nominated schools and found little evidence to confirm the expectation that CE programs in these schools might be particularly effective.

The following sections present the results for each of the five evaluation designs listed in Figure 2-1, with emphases on norm-referenced analysis and analysis of variance employing comparison groups that are similar with respect to achievement status. The findings from different designs are mostly in agreement, showing that Title I programs have been helpful in raising the participants' achievement. However, it is difficult to demonstrate the effectiveness of non-Title I CE programs probably because of their diverse aims which need not focus on improving basic skills. The results also indicate that program effects are more noticeable in math than in reading; modest effects of reading CE are generally found in the first three grades while similar effects of math CE are shown in all grades.

Comparison with Norm-Referenced Criteria

One of the major drawbacks of norm-referenced analyses is that the norms do not represent adequately the performance of the population of interest. First, the standardization sample frequently does not include a sufficient number of schools (the accuracy of norms depends on the number of schools rather than the number of students, Lord, 1959), and underrepresents minorities and disadvantaged students. Second, the tests are often administered to the standardization sample only at one time (fall or spring), with norms for other times obtained through interpolations and/or extrapolations. Occasionally, the tests are given in both fall and spring, but they may involve different groups of students and as a result the estimated norms do not reflect the effects of test-taking experience and may be confounded by the sample differences. Third, the testing times for evaluation often do not correspond to those for which empirical norms are available.

When the evaluation employs different test levels at the pretest and posttest, there is an added problem of inaccurate equating between test levels. Test publishers frequently based their interlevel articulations on data collected by administering different test levels or forms to different samples at only one testing time. Consequently, the articulations ignore the possible changes of inter-level relationships over time, and the equating errors may be enhanced because of nonequivalence between samples.

To overcome these difficulties, new norms (called the SES norms henceforth) were created that include a large number of schools from every segment of the population. Two adjacent levels of tests were administered to the same students in fall and spring to furnish data for the creation of norms and the equation of test levels. The great advantage of having these norms is that the standardization sample appropriately represents the population under study. These data also involve the exact time points for which the evaluation is performed. As a result, these norms in effect represent the projected performance of the study's subpopulations composed of elementary students at different achievement levels and at different grades. The difference score between pretest and posttest for a fixed percentile rank is commonly accepted in the education community as an approximation to the expected growth for a subpopulation of students initially achieving at that rank. By this way of approximation, the effects of CE can be estimated by comparing the observed growth for CE students with the difference between the pretest and posttest scores associated with a percentile rank that most typically represents their initial achievement levels. Because an almost longitudinal sample was used to derive the fall and spring norms, the fall-to-spring growth estimated from them more truthfully describes the expectations than would that from norms created with cross-sectional samples.

When the pretest and posttest employ different test levels, growth scores cannot be meaningfully obtained from the raw scores. In order to facilitate the measure of achievement growth, a common scale across test levels was created with the aforementioned 'longitudinal' data base. The test scores expressed in this scale are called vertical scale scores (VSS). The test levels were first equated separately in fall and spring and the two resulting scales were coordinated with statistical techniques to produce a scale that incorporates the inter-level relationships manifested at both times. In this way, we expect to achieve a better scale than the publisher's (see Report 9 for detailed description of the procedures for obtaining the VSS). Analyses for the first-year fall and spring data within grade are most likely to benefit from the greater validity of the growth scale.

Another advantage of the SES norms is that as percentile norms have been established empirically for two adjacent test levels at each administration for each grade, the two sets of norms based on different test levels can be jointly employed to obtain more accurate estimates of the expected scores.

Turning to the standards chosen to gauge the success of CE programs, two criteria of fall-to-spring growth are used:

A. *VSS gain required to maintain the group's fall percentile rank.* This criterion, referred to as 'percentile maintenance,' is based on the hypothesis of equi-percentile growth. It stipulates that without intervention, students maintain the same relative achievement status. Although studies on the validity of this assumption have either been inconclusive (Kaskowitz and Norwood, 1977) or suggested that there are positive, although small, biases in the estimates of the effects (Tallmadge and Wood, 1980), it is intuitively appealing, easy to understand, and has been popularly applied (e.g., Tallmadge and Wood, 1976; Coulson et al., 1975). The criterion can be implemented either on a group or individual basis. In the present context, implementation on the group basis is considered (application at the individual level is discussed in Appendix B1). To set the criterion for a group of students, the percentile rank corresponding to their mean fall VSS is first located using the fall norm, and then the VSS for the same percentile rank is obtained from the spring norm. The difference between the latter VSS and the mean fall VSS is the growth expected under 'normal' (no-program) conditions.

   Because CE students are included in establishing the national norms, there may be a concern about the contaminating CE effects in this criterion. However, such contamination is expected to have little influence in the conclusion of our evaluation. Suppose compensatory services have resulted in considerably better achievement for CE students; they would move up to the higher ranks. At the same time a group of non-CE students would move down to the lower ranks because of their relatively smaller gains. Consequently, the percentile-maintenance criterion would remain a good approximation of what the CE students would achieve had they received no compensatory services. (See Appendix B1 for further discussion of the appropriateness of this criterion.)

Two refinements of this criterion, one 'blocks' the groups by tenths of the score distribution to take into account differential growth rates at different achievement levels, and the other implements the criterion on an individual basis, are discussed in Appendix B1 along with the results of their analyses.

B. *Three-quarters of the VSS gain required to maintain the 50th percentile rank.* This criterion, referred to as 'deflated growth', is essentially a deflated growth for the typical student. The idea of deflated growth originates from previous findings that disdvantaged students tend to have slower growth rates. The choice of three-fourths as the deflation is also empirically based. As noted in the First Year of ESAA report (Coulson et al., 1975), the restandardization data show an average of two-thirds of the population growth rate for students in the minority-concentrated schools. Dividing pretest grade-equivalent (GE) scores by the number of months in school, Thomas and Pelavin (1976) estimated from state evaluation data a growth rate of about seven GE months per calendar year for Title I students. Interpreting ten GE months as the yearly growth for a typical student, this estimate amounts to a growth rate of .7 of the normal rate. Following a suggestion of Horst, Tallmadge, and Wood (1975) that an improvement equal to one-third of the standard deviation for the population distribution be considered educationally significant, David and Pelavin (1977) employed a criterion of eight GE months per calendar year (.8 of normal growth) in their evaluation. Despite the flaws of basing the estimates of growth rate on a GE score metric, we regard the finding of slower-than-normal growth for the educationally deprived children as quite plausible and believe that it is of interest to examine a criterion that reflects such a finding.

In light of these data, we chose three-quarters as an approximate deflation factor for setting the expected growth for CE students assuming no CE effects. This criterion is *unlikely* to be contaminated by the presence of CE students in the standardization sample, because both their pretest and posttest percentile ranks tend to be well below the median, as shown in Table 5-1 of Chapter 5. Under this circumstance, any presumed increment in gain for CE students would likely affect the population mean rather than the median.

Each criterion is intended as a benchmark against which the growth of CE students can be judged. In order to offer practical meaning to the results of our analyses, achievement growth for appropriate groups of non-CE students (i.e., the two comparison groups judged as needing CE) was examined in the same fashion so that the results can serve as reference points for judging the effectiveness of CE.

Traditionally, a significance test is carried out to decide if a criterion has been met. However, it is well known that when the sample is large a statistical significance can be obtained even if the actual difference is of no practical meaning. Hence, there is a recent emphasis on educational significance. The standard for educational significance as suggested by Horst et al. (loc. cit.) proves to be unsatisfactory, particularly because it is not of uniform stringency across grades (Kaskowitz and Norwood, 1977). We therefore elect not to use any kind of significance test, but rather a decision-based approach. We do this by presenting the observed data and the minimum values necessary to conclude that the criterion has been met with a certain confidence.

In a strict sense, a decision-theoretic approach would require explicit assessments of the evaluator's prior belief and personal utilities for different outcome status. We do not believe that a rigorous approach of this kind is practicable at present. A compromise is to base decisions on a reasonable rule that considers the current state of affairs only. As indicated in Chapter 1, there has been scant evidence of CE effectiveness. Furthermore, the delivery system is one of small increments of additional services to students who generally have histories of educational disadvantage for many years and who face non-compensatory school and environmental factors each day except during the period of compensatory instruction. Acknowledging these facts, we think that any positive findings are welcome encouragement and we feel justified in using a lenient rule for judging success, so that small positive effects do not go unnoticed.

The results of this approach are summarized in a way that the readers can make their own judgments on how likely it is that each criterion is exceeded. We do this by presenting the observed gain and the minimum gain necessary, for each criterion, to conclude that the criterion was exceeded with a probability greater than .9. This probability level was assessed from the posterior distribution for the mean gain, given the observed gain for the group under examination. Briefly, the posterior distribution is a 't' distribution with N-1 degrees of freedom (where N is the number of cases in the group), and location and scale parameters equal to the sample mean and standard error, when a non-informative prior is used and a normal distribution with unknown variance is assumed for the observations (Box and Tiao, 1973).

We chose the probability level of .9 as a threshold for detecting the effectiveness of CE. That is, if based on the observed data, the posterior probability for the mean gain to exceed a criterion is greater than .9, it is reported that there is a positive effect; if this probability is less than .1, there is no evidence for a positive effect; and if this probability lies between .1 and .9 there is ambiguous evidence and is reported as such. This particular strategy for summarizing the results underscores our primary interest in noting all positive effects, even if they are small. To serve a broader interest, we also report the means and standard deviations of the t-distributions so that one can adjust the probability level according to one's own opinion to arrive at personal decisions. The analyses were performed for all CE students together, and then separately for the three subgroups categorized by CE funding sources. For reasons noted earlier, analyses were also done for CE students in the nominated sample and for each of the two groups of non-CE students judged to need CE.

In addition, in order to examine differential effects according to various demographic characteristics of the schools, analyses were performed by geographic region, urbanism, minority and poverty concentrations, and low-achiever concentrations. As expenditures are raw indicators of effort, the last set of analyses deals with subgroups formed by school's expenditure level for regular and compensatory education. The findings of these latter analyses are tenuous and mostly inconsistent across grades, and therefore are not discussed in detail in the text. However, their results are presented in Appendix B1 (Tables B1-2 through B1-6).

In reading the tables that summarize the findings, the probability interpretations are as follows:

- If the lower limit exceeds the criterion, the probability for the mean gain to exceed the criterion is greater than .9 and thus a positive result is found according to our decision rule;
- If the criterion exceeds the upper limit, this probability is less than .1, and thus no positive result is concluded;
- And if the criterion lies between the two limits, this probability is between .1 and .9, and thus the evidence is ambiguous and decisions may be suspended.

We now discuss the results of the analyses. An example is provided to illustrate how to use the data in the tables to make decisions.

Analyses for All CE Students. The results for the analyses that include all CE students are presented in Table 2-1 and are summarized in Table 2-3 by expressing our conclusions in terms of the categories of decisions supported by the data.

As an example, we find from the first row of Table 2-1 that, for grade 1, the average school-year gain in reading scores is 58.64 for CE students, with a standard error of .54. The lower limit of the 80 percent credibility interval is 57.96, indicating that the probability for the 'true mean gain' to exceed this value is .90. It follows that the probability for the mean gain to exceed 55 (the percentile-

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maintenance criterion) is greater than .90 as 55 is smaller than 57.96. We thus conclude that there is a positive CE effect in reading at grade 1, and enter a '+' into the first entry of the first column in Table 2-3.

On the other hand, the data in the fifth row of Table 2-1 show that, in reading for grade 5, the probability for CE students to have a mean larger than 26.10 (the upper limit of the 80 percent credibility interval) is only .10. This information indicates a probability of less than .10 that the mean gain for CE students exceeds the percentile-maintenance criterion, 27 (because 27 is greater than 26.10). According to our decision rule, we conclude that there is no evidence for positive CE effects in reading at grade 5. In fact, the result implies a high probability (.9) that the average gain of CE students falls short of the percentile-maintenance criterion. This negative finding is noted in Table 2-3 by a '-' in the fifth entry of the first column.

The data in the third row of Table 2-1 illustrate yet another situation. For grade 3 in reading, the probabilities are .90 and .10 for the mean gain to exceed 33.64 and 34.91 (the limits of the 80 percent credibility interval), respectively. Thus, the probability that the percentile-maintenance criterion (34) is exceeded lies somewhere between .1 and .9, a result that provides ambiguous evidence for the effects of CE. We then indicate this ambiguity and our unwillingness to make a judgment one way or the other by a '.' in the third entry of the first column in Table 2-3.

Table 2-1

Average Fall-to-Spring VSS Gain for CE Students and Criteria for Gain

Grade	Fall-to Spring VSS Gain*			80% Credibility Interval		Criteria for Gain**	
	Mean	S.D.	S.E.	Lower Limit	Upper Limit	Percentile Maintenance	Deflated Growth
				Reading			
1	58.64	35.34	.54	57.96	59.33	55	50
2	42.89	35.58	.52	42.23	43.56	41	35
3	34.28	33.45	.50	33.64	34.91	34	26
4	30.39	37.51	.60	29.62	31.16	31	22
5	25.34	35.41	.59	24.59	26.10	27	20
6	25.34	35.73	.60	24.57	26.12	29	20
				Math			
1	60.33	36.92	.70	59.43	61.23	53	47
2	53.70	39.59	.75	52.74	54.66	51	42
3	52.76	42.57	.79	51.76	53.77	59	43
4	48.05	44.17	.86	46.95	49.15	48	46
5	41.68	44.86	.90	40.54	42.83	39	29
6	40.86	46.54	.94	39.66	42.07	41	39

*Sample sizes (N) for each group can be obtained by adding up the N's for the three CE groups in Table 2-2.

**Percentile Maintenance = VSS gain required to maintain a percentile rank associated with the mean fall VSS for the group.

Deflated Growth = Three-fourths of the VSS gain required to maintain the 50th percentile rank.

Inspection of Table 2-3 reveals that the percentile-maintenance criterion is satisfied at grades 1 and 2 for reading and at grades 1, 2, and 5 for math, and the deflated-growth criterion is met in both reading and math at all grades. (In a later chapter, we will present data to show the actual magnitude of gains for CE students relative to the 'median' growth; see Tables E-1 and E-2 of Appendix E.) Overall, the results indicate greater CE effectiveness in the earlier two grades.

Analyses for Subgroups of CE Students by Funding Categories. Table 2-2 provides the detailed results for these analyses. For ease of interpretation, a summary of the results is also given in Table 2-3 following the strategy taken in the preceding analyses. The summary table shows that:

- Again, the deflated-growth criterion is satisfied in nearly all cases. Exceptions are found in math for grades 4 and 6, where no positive CE effects for other-CE students can be concluded on the basis of this criterion.
- Positive CE effects for other-CE students in Title I schools are mostly not evident as judged by the percentile-maintenance criterion. For other-CE students in other-CE schools, consistent positive results can be found only in reading for grade 2. Elsewhere, little evidence of positive effect is observed for this group.
- In contrast, positive results with the percentile-maintenance criterion are consistently obtained for Title I students in math with an exception at grade 3. Not surprisingly, similar results for Title I students and for all CE students are obtained, a consequence of the large proportion of CE students being served by Title I. Because there are sufficient sample sizes for all three subgroups, the present findings suggest a more promising picture for Title I students than for others.

Analyses for CE Students in the Nominated Sample. Table 2-4 contains the results. Following the same decision strategy for drawing conclusions (see Table 2-6 for a summary), we find:

- The deflated-growth criterion is satisfied in all occasions.
- Positive effects in reading for grades 1 and 2, and in math for grades 1, 2, 4, and 5 are obtained based on the percentile-maintenance criterion.

To summarize, there are no indications from these analyses that CE is particularly effective in the nominated schools, and thus including CE students from these schools in the general analyses cannot be expected to distort the results of the national evaluation.

Analyses for Reference Groups of Non-CE Students. Similar analyses were also performed for the needy non-CE students in CE schools and for those in non-CE schools. The following observations which are summarized in Table 2-6 may be made from the detailed data presented in Table 2-5:

- The results for the two groups are quite similar. One difference is noticeable in math for grade 4, where positive findings are obtained for the group in CE schools, but not for the group in non-CE schools.
- In general, the deflated-growth criterion is satisfied, while positive findings are evident with the percentile-maintenance criterion in reading only in grade 1 and in math for grades 4 and 5.

In short, fewer positive results are obtained for these groups of non-CE students, suggesting that some real CE effects are uncovered, particularly for the first and second grades in math and for the second grade in reading.

Table 2-2

Average Fall-to-Spring VSS Gain for the Three Groups of CE Students and Criteria for Gain

GRADE	CE Group*	Sample Size	Fall-to-Spring VSS Gain			80% Credibility Interval		Criteria for Gain**	
			Mean	S.D.	S.E.	Lower Limit	Upper Limit	Percentile Maintenance	Deflated Growth
					Reading				
1	Title I	2,785	59.23	35.06	.66	58.37	60.08	57	50
	Other in Title I	987	59.59	34.72	1.11	58.18	61.01	63	50
	Other in Other	574	54.18	37.44	1.56	52.18	56.18	64	50
2	Title I	3,036	42.68	35.37	.64	41.85	43.50	43	35
	Other in Title I	948	41.31	34.18	1.11	39.89	42.73	41	35
	Other in Other	704	45.96	38.08	1.44	44.12	47.80	40	35
3	Title I	3,022	35.31	32.52	.59	34.55	36.06	33	26
	Other in Title I	884	30.56	34.50	1.16	29.08	32.05	40	26
	Other in Other	629	34.55	35.97	1.43	32.72	36.39	35	26
4	Title I	2,392	31.35	37.92	.78	30.36	32.35	32	22
	Other in Title I	864	28.46	35.79	1.22	26.91	30.02	32	22
	Other in Other	619	29.36	38.21	1.54	27.40	31.33	35	22
5	Title I	2,227	25.19	35.56	.75	24.23	26.16	31	20
	Other in Title I	802	23.89	32.91	1.16	22.41	25.38	27	20
	Other in Other	587	27.88	37.92	1.57	25.88	29.89	26	20
6	Title I	1,982	26.01	37.32	.84	24.94	27.08	30	20
	Other in Title I	905	26.85	32.75	1.09	25.46	28.24	28	20
	Other in Other	620	21.01	34.40	1.38	19.24	22.78	29	20
					Math				
1	Title I	1,598	61.57	37.04	.93	60.38	62.75	52	47
	Other in Title I	855	57.20	35.24	1.21	55.65	58.74	61	47
	Other in Other	329	62.46	40.07	2.21	59.63	65.29	61	47
2	Title I	1,686	53.45	40.61	.99	52.18	54.72	51	42
	Other in Title I	808	53.97	36.99	1.30	52.31	55.64	57	42
	Other in Other	291	54.36	40.73	2.39	51.30	57.42	55	42
3	Title I	1,793	55.36	40.40	.95	54.14	56.58	60	43
	Other in Title I	768	49.80	45.28	1.63	47.71	51.89	58	43
	Other in Other	369	46.32	45.91	2.39	43.26	49.38	56	43
4	Title I	1,434	53.38	42.57	1.12	51.94	54.82	48	46
	Other in Title I	845	45.26	42.60	1.47	43.38	47.14	55	46
	Other in Other	373	33.88	49.79	2.58	30.58	37.18	52	46
5	Title I	1,331	43.84	44.67	1.22	42.28	45.42	37	29
	Other in Title I	768	37.68	44.07	1.59	35.64	39.72	43	29
	Other in Other	400	42.18	46.57	2.33	39.20	45.16	41	29
6	Title I	1,134	44.02	47.84	1.42	42.21	45.84	42	39
	Other in Title I	858	39.18	45.69	1.56	37.19	41.18	49	39
	Other in Other	457	36.18	44.30	2.07	33.52	38.83	43	39

* Title I = Title I students; Other in Title I = Other-CE students in Title I schools; and other in Other = Other-CE students in other-CE schools.

** Percentile Maintenance = VSS gain required to maintain a percentile rank associated with the mean fall VSS for the group.

Deflated Growth = Three-fourths of the VSS gain required to maintain the 50th percentile rank.

Table 2-3

Summary Results for the Extent That CE Students Have Attained an Average Achievement Growth Exceeding the Percentile-Maintenance and Deflated-Growth Criterion, by CE Categories*

Grade	All CE Students		CE Group					
			Title I Students in Title I Schools		Other-CE Students in Title I Schools		Other-CE Students in Other-CE Schools	
	Percentile Maintenance	Deflated Growth	Percentile Maintenance	Deflated Growth	Percentile Maintenance	Deflated Growth	Percentile Maintenance	Deflated Growth
Reading								
1	+	+	+	+	-	+	-	+
2	+	+	.	+	.	+	+	+
3	.	+	+	+	-	+	.	+
4	.	+	.	+	-	+	-	+
5	-	+	-	+	-	+	.	+
6	-	+	-	+	.	+	-	+
Math								
1	+	+	+	+	-	+	.	+
2	+	+	+	+	-	+	.	+
3	-	+	-	+	-	+	-	+
4	.	+	+	+	-	.	-	-
5	+	+	+	+	-	+	.	+
6	.	+	+	+	-	.	-	-

* '+', '.', and '-' represent that probabilities of exceeding a criterion are greater than .9, between .1 and .9, and less than .1, respectively.

The criteria employed for the achievement growth are:
Percentile Maintenance: VSS gain required to maintain a percentile rank associated with the mean fall VSS for the group.
Deflated Growth: Three-fourths of the VSS gain required to maintain the 50th percentile rank.

Table 2-4

Average Fall-to-Spring VSS Gain for CE Students in Nominated Schools and Criteria for Gain

Grade	Sample Size	Fall-to-Spring VSS Gain			80% Credibility Interval		Criteria for Gain*	
		Mean	S.D.	S.E.	Lower Limit	Upper Limit	Percentile Maintenance	Deflated Growth
				Reading				
1	1,566	63.36	36.19	.91	62.19	64.53	56	50
2	1,553	43.15	35.50	.90	42.00	44.31	41	35
3	1,475	35.45	34.13	.89	34.31	36.59	36	26
4	1,059	29.22	38.81	1.19	27.69	30.74	33	22
5	968	23.52	34.75	1.12	22.10	24.95	29	20
6	952	25.85	37.40	1.21	24.30	27.41	29	20
				Math				
1	1,030	65.77	37.45	1.17	64.28	67.26	55	47
2	1,117	54.74	39.88	1.19	53.21	56.26	53	42
3	1,116	50.12	41.18	1.23	48.55	51.70	58	43
4	773	49.07	44.71	1.61	47.01	51.13	46	46
5	751	41.64	45.62	1.66	39.51	43.77	39	29
6	705	42.46	46.92	1.77	40.19	44.72	42	39

*Percentile Maintenance: VSS gain required to maintain a percentile rank associated with the mean fall VSS for the group.

Deflated Growth: Three-fourths of the VSS gain required to maintain the 50th percentile rank.

Table 2-5

Average Fall-to-Spring VSS Gain for Non-CE Students Who Were Judged To Be in Need of CE and Criteria for Gain

GRADE	Availability of Reading/Math CE in School	Sample Size	Fall-to-Spring VSS Gain			80% Credibility Interval		Criteria for Gain*	
			Mean	S.D.	S.E.	Lower Limit	Upper Limit	Percentile Maintenance	Deflated Growth
					Reading				
1	Not Available	541	52.79	36.70	1.58	50.78	54.81	49	50
	Available	1,999	54.83	35.20	.79	53.82	55.84	50	50
2	Not Available	678	38.41	36.95	1.42	36.60	40.23	44	35
	Available	1,572	39.79	35.28	.89	38.65	40.93	42	35
3	Not Available	591	29.48	37.16	1.53	27.53	31.44	33	26
	Available	1,473	34.10	33.92	.88	32.97	35.23	36	26
4	Not Available	613	30.25	34.95	1.41	28.44	32.06	32	22
	Available	1,729	30.10	36.80	.89	28.97	31.23	35	22
5	Not Available	548	22.60	36.48	1.56	20.60	24.59	27	20
	Available	1,899	24.74	34.85	.80	23.71	25.76	28	20
6	Not Available	676	25.14	36.15	1.39	23.36	26.92	28	20
	Available	2,124	23.89	35.44	.77	22.90	24.87	29	20
					Math				
1	Not Available	1,051	49.13	35.91	1.11	47.72	50.55	55	47
	Available	1,599	54.13	35.65	.89	52.99	55.28	54	47
2	Not Available	1,035	46.74	40.26	1.25	45.14	48.35	53	42
	Available	1,353	50.47	38.89	1.06	49.11	51.82	53	42
3	Not Available	1,057	50.11	42.66	1.31	48.43	51.79	59	43
	Available	1,370	49.07	39.29	1.06	47.71	50.43	58	43
4	Not Available	1,169	46.97	45.30	1.32	45.28	48.67	46	46
	Available	1,455	48.22	42.51	1.11	46.79	49.65	46	46
5	Not Available	1,270	35.75	45.34	1.27	34.12	37.38	37	29
	Available	1,606	38.86	44.72	1.12	37.43	40.29	35	29
6	Not Available	1,321	33.73	47.66	1.31	32.05	35.41	43	39
	Available	1,767	35.43	44.79	1.07	34.07	36.80	39	39

*Percentile Maintenance: VSS gain required to maintain a percentile rank associated with the mean fall VSS for the group.

Deflated Growth: Three-fourths of the VSS gain required to maintain the 50th percentile rank.

Table 2-6

Summary Results for the Extent That an Average Achievement Growth Exceeding the Percentile-Maintenance and Deflated-Growth Criteria Has Been Attained, for CE Students in the Nominated Sample and for Two Groups of Non-CE Students Judged as Needing CE*

Grade	Analysis Groups					
	CE Students in Nominated Schools		Needy Non-CE Students in CE Schools		Needy Non-CE Students in Non-CE Schools	
	Percentile Maintenance	Deflated Growth	Percentile Maintenance	Deflated Growth	Percentile Maintenance	Deflated Growth
Reading						
1	+	+	+	+	+	+
2	+	+	-	+	-	+
3	.	+	-	+	-	+
4	-	+	-	+	.	+
5	-	+	-	+	-	+
6	-	+	-	+	-	+
Math						
1	+	+	.	+	-	+
2	+	+	-	+	-	+
3	-	+	-	+	-	+
4	+	+	+	+	.	.
5	+	+	+	+	.	+
6	.	+	-	-	-	-

* '+', '.', and '-' represent that probabilities of exceeding the criterion are greater than .9, between .1 and .9, and less than .1, respectively.

Percentile Maintenance: VSS gain required to maintain a percentile rank associated with the mean fall VSS for the group.

Deflated Growth: Three-fourths of the VSS gain required to maintain the 50th percentile rank.

Another result worth noting is that the three-fourths deflation factor for growth yields a criterion that is very easily satisfied. Clearly, CE students learn more than that during the school year. Indeed, we can observe from Table E-1 of Appendix E that, in reading, Title I students achieved average gains between 89 to 106 percent of the 'median' growth (VSS gain required to maintain the 50th percentile rank); while Needy Non-CE Students in Non-CE Schools gain between 79 to 103 percent of the median growth. Similarly, the data in Table E-2 show that, in math, the corresponding percentages range from 86 to 114 percent for Title I students, compared with a range between 66 and 93 percent for Needy Non-CE Students in Non-CE Schools. (In Tables E-1 and E-2, the average gains for each of the three subgroups of CE students and the two subgroups of Needy Non-CE students are expressed in terms of percentages of the gains achieved by the median performers at the respective grades.)

Analyses by Demographic Characteristics of Schools. As noted earlier, similar analyses were also applied to data from subsets of schools with different demographic characteristics so that differential CE effects according to school characteristics could be examined. On the whole, these analyses have not produced easily interpretable results. More important, there are few indications that subsetting schools into more homogeneous groups would help sort out the complex phenomena of CE effects. We therefore relegate discussion of the results for these analyses to Appendix B1.

Conclusions from Norm-Referenced Analyses. In conclusion, the norm-referenced analyses reveal:

- The deflated growth factor of three-fourths appears to be an unnecessarily pessimistic expectation. The criterion of maintaining the fall percentile rank yields some meaningful results, and is likely a reasonable expectation.

- Positive CE effects are more frequent in grades 1 and 2. The impacts of CE on achievement growth are more noticeable in math than in reading.

- More consistent positive CE effects are observed for Title I students than for other-CE students. This is an encouraging finding, particularly in view of the prevalence of Title I programs and their concentrated efforts over the years.

- Finally, the subset analyses by school's demographic characteristics prove to be not very fruitful, and their results are therefore presented in the Appendix.

The implementation of the percentile-maintenance criterion on an individual basis generally confirms the findings from the group analyses, with some method-caused exceptions. The results are reported in Appendix B1.

Differences in Achievement Growth Between CE and Non-CE Students

In this section we compare the achievement growth among CE students and various groups of non-CE students in order to assess the effects of CE. The analysis-of-variance technique is employed to examine the differences in achievement gains among groups. As a first solution, ANOVAs are performed for the six CE groups generally employed in the earlier SES reports (see page 2-11), though these groups differ substantially in pretest scores.

Because the expected faster growth rate for the groups of non-CE students can lead to unrealistically high comparison standards for the CE students, we perform a more penetrating set of ANOVAs in which the three groups of non-CE students are replaced with two non-CE comparison groups whose initial achievement and judged need of CE are similar to those for the CE students. The two non-CE comparison groups are: students judged as needing CE and attending schools that provide CE in the subject (needy non-CE students in CE schools), and students who are judged as needing CE but attending schools that do not provide CE in the subject (needy non-CE students in non-CE schools). Thus, five groups of students are involved in the second set of analyses: the three groups of CE students and two comparison groups of needy non-CE students.

To make the comparisons even sharper, by reducing further the preexisting differences in achievement, we perform a third set of analyses that differentiate both CE and non-CE students with respect to their judged need for CE. In these analyses, CE status and teacher's judgment of need for CE (as made at the beginning of the study, i.e., during the October-November period of 1976) constitute the two factors for the two-way ANOVA design. These analyses also address the concern that CE services will help only the students with educational need and should not be provided to those who do not have such need.

For the first two sets of the ANOVAs, two kinds of gain scores are analyzed: simple VSS gain and standardized gain scores. As pointed out by Kenny (1975), the standardized gain scores are appropriate for the evaluation of program effects when the fan-spread hypothesis is assumed. (For an explanation of the fan-spread hypothesis, see the first section of Chapter 3.)

Analysis of Variance for the Six CE Groups. To control for the substantial differences in initial achievement among the groups, and thereby provide more sensitive comparisons, a blocking factor of pretest achievement status is introduced into this set of analyses. Two blocks are formed for each of the analysis groups: the 'bottom third' block consisting of students who scored at or below the 33rd percentile rank with both the at-level and below-level tests, and the 'top two-thirds' block comprising the rest of the students. The blocking is based on both the at-level and below-level test scores in order to reduce regression effects due to test unreliabilities. The choice of the 33rd percentile to form the achievement blocks is arbitrary, but made mainly because it is close to the average for the CE students.

Table 2-7 summarizes the results of the two-way ANOVAs in terms of VSS gains for reading and math. We should first note that in grade 1 the sample sizes (see Tables B2-1 and B2-2) show that an unexpectedly small number of students is in the 'bottom third' block, a phenomenon largely due to the low test reliabilities in the first grade.

Looking at the means within each of the analysis groups, one observation stands out. The average gain for the 'bottom third' subgroup is almost always greater than that for the 'top two-thirds' subgroup. This finding holds across the six CE groups, and in all grades for both reading and math. The greater gain for the lower-achieving subgroup clearly suggests a regression-toward-the-mean effect. As illustrated in Figures 2-2, for reading, and 2-3, for math, the growth rate is generally lower for the lower-achieving groups of non-CE students, in comparison with the overall growth rate for such students. (Average gain scores for these students can be found in Tables B2-6 and B2-7 of Appendix B2.) Furthermore, data in Figures 1-1, for reading, and 1-2 for math, of Technical Report 9 also show generally higher growth rates at the higher percentiles of the SES norms.

In light of these observations, the larger mean VSS gains for the lower-achieving subgroups within each CE/non-CE category are likely indications of regression artifacts. Indeed, within the groups of CE students, one can argue that those who achieved in the top two-thirds at the pretest time could have done so by chance, and they are therefore expected to make lower gains as a result of regression to their own true scores. Conversely, within the groups of non-CE students in CE schools, the low pretest scores for those who scored at the bottom one-third are partially reflections of negative measurement errors, and consequently regression would explain some of their higher gains. By this line of reasoning, we are quite certain that the significant block effects in Table 2-7 are likely results of regression artifacts rather than of differential growth rates.

Examining the interaction effects, we find significances in grades 2 and 5 for reading, and in grades 3 and 5 for math. Considering the extremely large samples, and the relatively small F-ratios, these interaction effects may be regarded mostly as a result of large sample sizes. Accordingly, the significant tests on the main effects of CE groups give similar results whether the interaction effects are adjusted for or not. The only exception to this is observed in reading at grade 4, where both of the two F-ratios are in the vicinity of the critical value, though adjustment of the interaction effects renders the main effects of CE groups significant (at the .01 level).

Table 2-7

Two-Way ANOVA of Fall-to-Spring Reading and Math VSS Gains by CE Status and Initial Achievement Status

GRADE	Initial Achievement Status (A)	CE Status (B)						TOTAL	Test Statistics	
		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Non-CE Students in Title I Schools	Non-CE Students in Other-CE Schools	Students in Non-CE Schools		Effect*	F
		Reading Gain Score Means								
1	Bottom Third	60.7	59.8	56.1	69.3	69.1	70.0	6[illegible].6	A	2.54
	Top Two Thirds	58.5	59.5	53.5	67.3	65.2	64.9	64.5	B|A	41.97**
	TOTAL	59.2	59.6	54.2	67.6	65.6	66.0	64.7	A×B|A,B B|A,A×B	0.71 32.04**
2	Bottom Third	45.2	43.1	51.0	43.2	51.4	44.1	45.2	A	29.24**
	Top Two-Thirds	39.1	40.3	41.0	43.2	42.4	41.4	42.1	B|A	3.38**
	TOTAL	42.7	41.3	46.0	43.2	43.4	42.2	43.0	A×B|A,B B|A,A×B	6.11** 4.87**
3	Bottom Third	37.3	35.3	38.2	36.0	40.3	37.2	37.1	A	87.36**
	Top Two-Thirds	31.5	26.9	30.5	31.4	34.6	31.7	32.0	B|A	7.37**
	TOTAL	35.3	30.6	34.6	32.3	35.3	33.2	33.6	A×B|A,B B|A,A×B	0.66 4.65**
4	Bottom Third	34.6	29.8	32.2	35.4	36.6	36.1	34.6	A	149.69**
	Top Two-Thirds	24.9	27.3	26.0	27.9	27.4	28.4	27.5	B|A	2.59
	TOTAL	31.4	28.5	29.4	29.5	28.8	30.6	29.7	A×B|A,B B|A,A×B	1.70 3.04**
5	Bottom Third	26.1	22.7	29.4	26.3	32.2	31.7	27.6	A	1.95
	Top Two-Thirds	22.1	25.1	25.2	26.7	28.8	25.9	26.9	B|A	9.46**
	TOTAL	25.2	23.9	27.9	26.6	29.4	27.8	27.1	A×B|A,B B|A,A×B	4.24** 10.77**
6	Bottom Third	28.0	27.9	22.9	28.1	26.4	27.2	27.2	A	36.89**
	Top Two-Thirds	20.5	25.7	17.3	25.3	23.4	24.2	24.1	B|A	5.76**
	TOTAL	26.0	26.9	21.0	25.9	24.0	25.2	25.1	A×B|A,B B|A,A×B	1.60 5.43**
		Math Gain Score Means								
1	Bottom Third	64.6	63.1	62.8	64.8	65.8	60.1	64.1	A	25.83**
	Top Two-Thirds	59.3	55.2	62.3	62.8	59.5	57.9	60.8	B|A	11.02**
	TOTAL	61.6	57.2	62.5	63.2	60.4	58.4	61.5	A×B|A,B B|A,A×B	1.99 5.85**
2	Bottom Third	55.3	58.5	53.8	60.0	61.2	54.0	58.1	A	33.47**
	Top Two-Thirds	51.2	51.[illegible]	54.7	54.4	56.2	52.3	54.2	B|A	7.10**
	TOTAL	53.5	54.0	54.4	55.8	57.1	52.7	55.3	A×B|A,B B|A,A×B	1.13 6.89**
3	Bottom Third	59.3	55.4	42.9	60.2	63.0	58.1	59.2	A	16.03**
	Top Two-Thirds	48.9	46.2	48.8	56.2	60.6	57.4	56.4	B|A	20.06**
	TOTAL	55.4	49.8	46.3	57.2	61.1	57.6	57.2	A×B|A,B B|A,A×B	4.39** 16.82**
4	Bottom Third	56.3	45.5	40.3	55.8	54.2	54.3	54.[illegible]	A	55.22**
	Top Two-Thirds	48.7	45.1	28.8	48.7	50.6	48.7	48.6	B|A	17.25**
	TOTAL	53.4	45.3	33.9	50.4	51.3	50.2	50.2	A×B|A,B B|A,A×B	1.76 16.40**
5	Bottom Third	47.1	40.6	46.7	42.7	45.9	51.0	45.2	A	3.15
	Top Two-Thirds	37.4	35.8	36.1	43.0	47.8	44.4	43.8	B|A	10.44**
	TOTAL	43.8	37.7	42.2	42.9	47.4	46.4	44.2	A×B|A,B B|A,A×B	5.39** 8.53**
6	Bottom Third	48.7	43.8	39.6	44.6	42.[illegible]	40.5	43.9	A	53.03**
	Top Two-Thirds	37.7	35.6	31.5	38.9	38.2	38.7	38.4	B|A	2.52
	TOTAL	44.0	39.2	36.2	40.4	39.2	39.2	39.9	A×B|A,B B|A,A×B	1.69 2.61

Note. — Sample sizes for each group and means reported to two decimal places are provided in Table B2-1 and B2-2 in Appendix B2.

*Notations: A×B = interaction effect; B|A (B|A, A×B) = B effect conditional on A (A and A×B) effect(s).

**F-test is significant at .01 level.

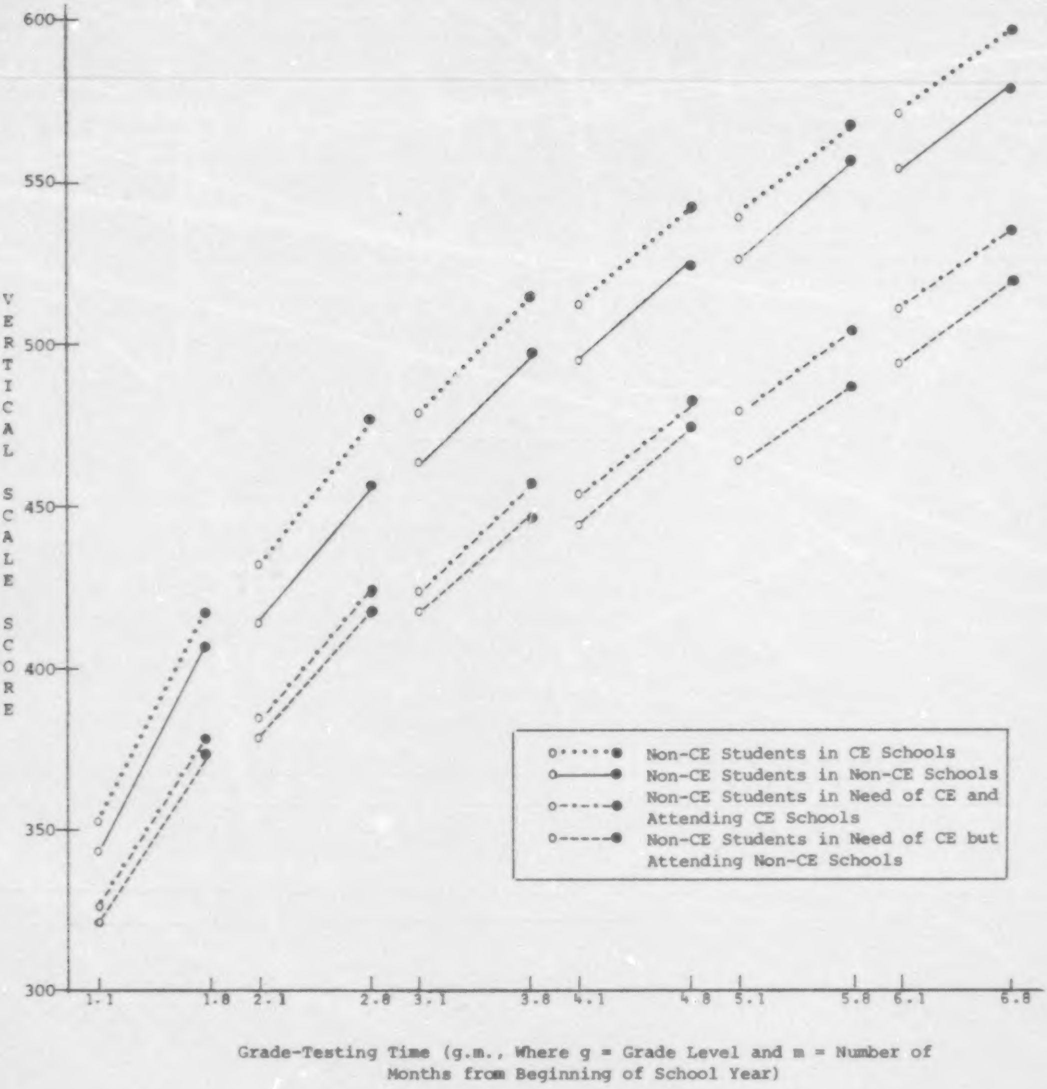

Figure 2-2

Mean CTBS Reading Scores in Fall and Spring for Four Groups of Non-CE Reading Students by Grade

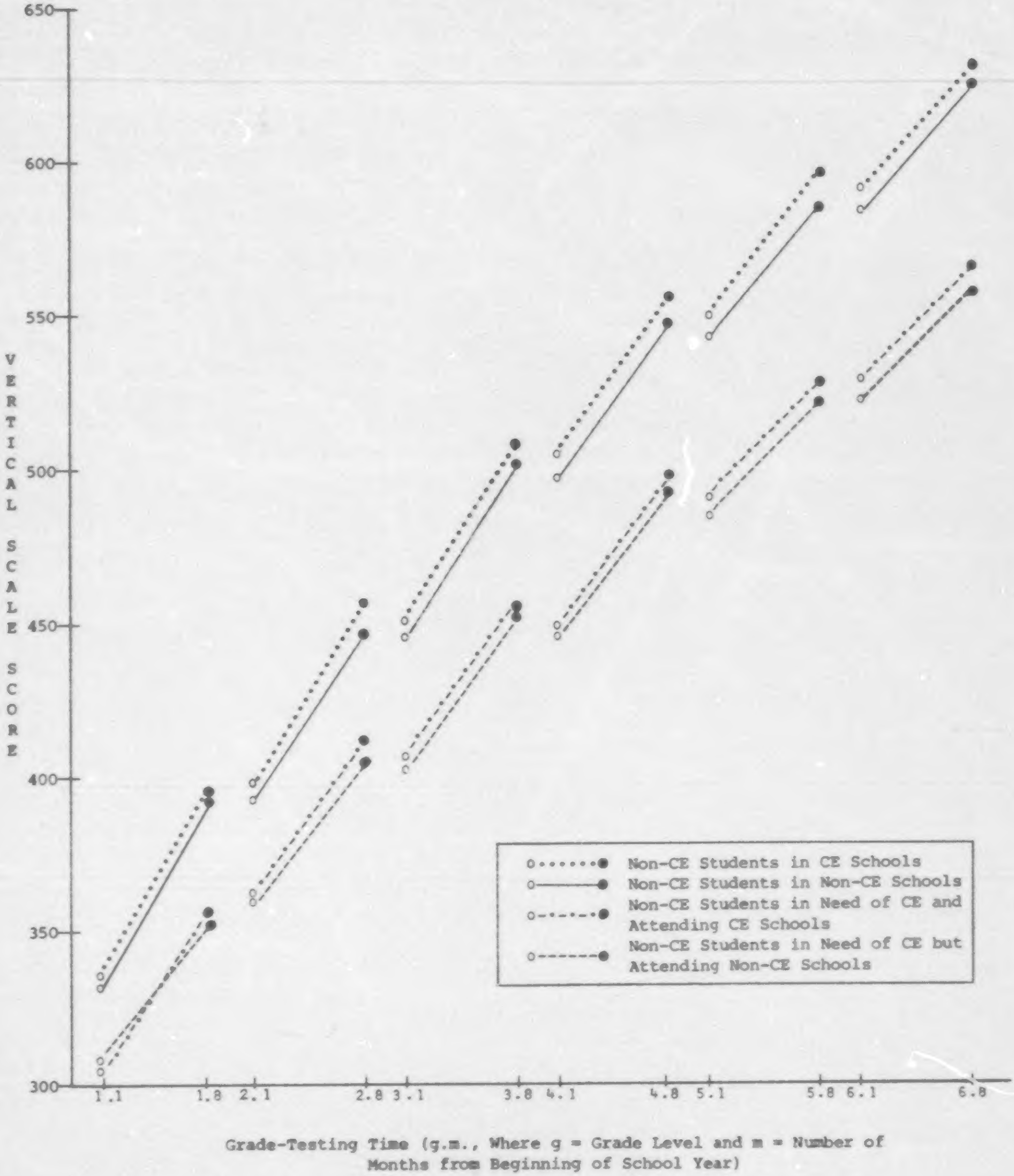

Figure 2-3

Mean CTBS Math Scores in Fall and Spring for Four Groups of Non-CE Math Students by Grade

Inspection of the marginal means for the six analysis groups does not show consistent patterns across the grades. However, there are some indications that average gains for the non-CE students tend to be larger than for the CE students. We believe that the differential growth rates among groups of students with different initial ability account for most of such findings. Additionally, Title I students appear to make slightly higher gains than non-Title I students in the same schools. On the whole, the findings from these analyses are difficult to interpret because they suffer from severe confounding effects of regression and differential growth rate. Based on these considerations, we do not recommend the practice of blocking in terms of pretest scores when gain scores are analyzed. These analyses are performed merely for the purpose of providing background information to aid in the understanding of different growth patterns among the groups.

In terms of the fan-spread hypothesis, the problem of differential growth rates may be alleviated by examining standardized gain scores instead of simple VSS gains. Because we created empirical norms for both the pretest and posttest, the standardized gains scores can be derived by converting the percentile scores to standardized normal deviates (z-scores). The z-score gain then represents the standardized gain score based on the projected distribution of test scores in the population. Computing this kind of score is usually not feasible, because most evaluations have to rely on standardized gain scores derived from the distribution of scores in the study sample. In order to investigate the influence of basing standardized gain scores on sample data, we also performed similar analyses employing standardized gain scores derived from the sample distribution of the entire first-year SES test data.

In the analyses of standardized gain scores, blocking by pretest status is not necessary, as these gain scores are calculated to mitigate against the confounding effects arising from different pretest levels. The results of the ANOVAs in terms of standardized gain scores based on the projected population norm (i.e., z-scores) are presented in Table 2-8. The data reveal some different results from those in the analysis of VSS gains. The greater gains for Title I students, in comparison with other groups, are more discernible on the basis of standardized gain scores than VSS gains. This finding is particularly pronounced for math, for which Title I students make significantly larger gains in all grades but grade 2. For reading, average gains for Title I students are significantly larger than other groups in grades 2, 3 and 6. The significant F-statistics in grades 1 and 5 reflect primarily the differences among the three groups of CE students. Practically identical results are obtained in the analyses using standardized gain scores derived from the score distributions of the study sample. The sample-based results are summarized in Table B2-3 of Appendix B2.

Analysis of Variance for CE and Needy Non-CE Groups. In this set of analyses, two groups of non-CE students judged as needing CE, instead of the original three non-CE groups, serve as the comparisons. This new composition of the analysis sample makes direct comparisons among the groups in terms of VSS gains more appropriate for the evaluation of CE effects. This is so because the two comparison groups are similar to CE students with respect to educational status and thus can provide more reasonable approximations to the expected gain for CE students, assuming there is no CE. Since blocking by initial achievement status is not important in this case, simple one-way ANOVAs for the five groups were performed.

The pretest and posttest mean VSSs for the five groups are plotted in Figures 2-4, for reading, and 2-5, for math. Although the pretest means are not identical among the groups, we expect regression artifacts to play a negligible role in the findings. When the mean pretest differences are small and sample sizes are large for the groups, the regressions of group means toward the overall mean tend to be minute (see Lindley, 1971; Lindley and Smith, 1972; and Wang, Novick, Isaacs, and Ozenne, 1977). The line segments in these figures are deliberately not connected between grades, so as to reduce the reader's temptation to interpret the data as longitudinal. The data are longitudinal within each grade, but not over the grades.

Table 2-8

One-Way ANOVA of Fall-to-Spring Reading and Math Gains in Terms of Standardized Normal Deviate (z) Scores, by CE Status

CE Status	Gr.1	Gr.2	Gr.3	Gr.4	Gr.5	Gr.6
Mean Reading Gains						
Title I Students in Title I Schools	.01	.03	.07	.03	-.00	.03
Other-CE Students in Title I Schools	-.05	-.05	.00	-.02	-.03	.02
CE Students in Other-CE Schools	-.16	.08	.04	.00	.03	-.05
Non-CE Students in Title I Schools	.04	-.04	.00	-.01	-.01	-.01
Non-CE Students in Other-CE Schools	-.07	-.05	.02	-.01	.02	-.04
Students in Non-CE Schools	.05	-.05	.01	.02	.01	-.01
Total	.00	-.02	.02	-.00	.00	-.02
F Statistic	14.97*	10.58*	6.13*	2.59	3.87*	11.07*
Mean Math Gains						
Title I Students in Title I Schools	.12	.04	.13	.08	.09	.09
Other-CE Students in Title I Schools	-.06	-.02	-.01	-.08	-.04	-.01
CE Students in Other-CE Schools	.07	.02	-.17	-.21	.04	-.02
Non-CE Students in Title I Schools	.04	-.00	.02	-.04	-.01	-.04
Non-CE Students in Other-CE Schools	-.06	.00	-.03	-.03	.01	-.07
Students in Non-CE Schools	-.06	-.04	-.01	-.03	.05	-.05
Total	.01	-.00	.01	-.03	.01	-.04
F Statistic	19.50*	2.32	17.65*	15.39*	8.59*	15.58*

Note. — Sample sizes for each group can be found in Table B2-3 of Appendix B2.

*Means differ significantly among the six CE groups at the .01 level.

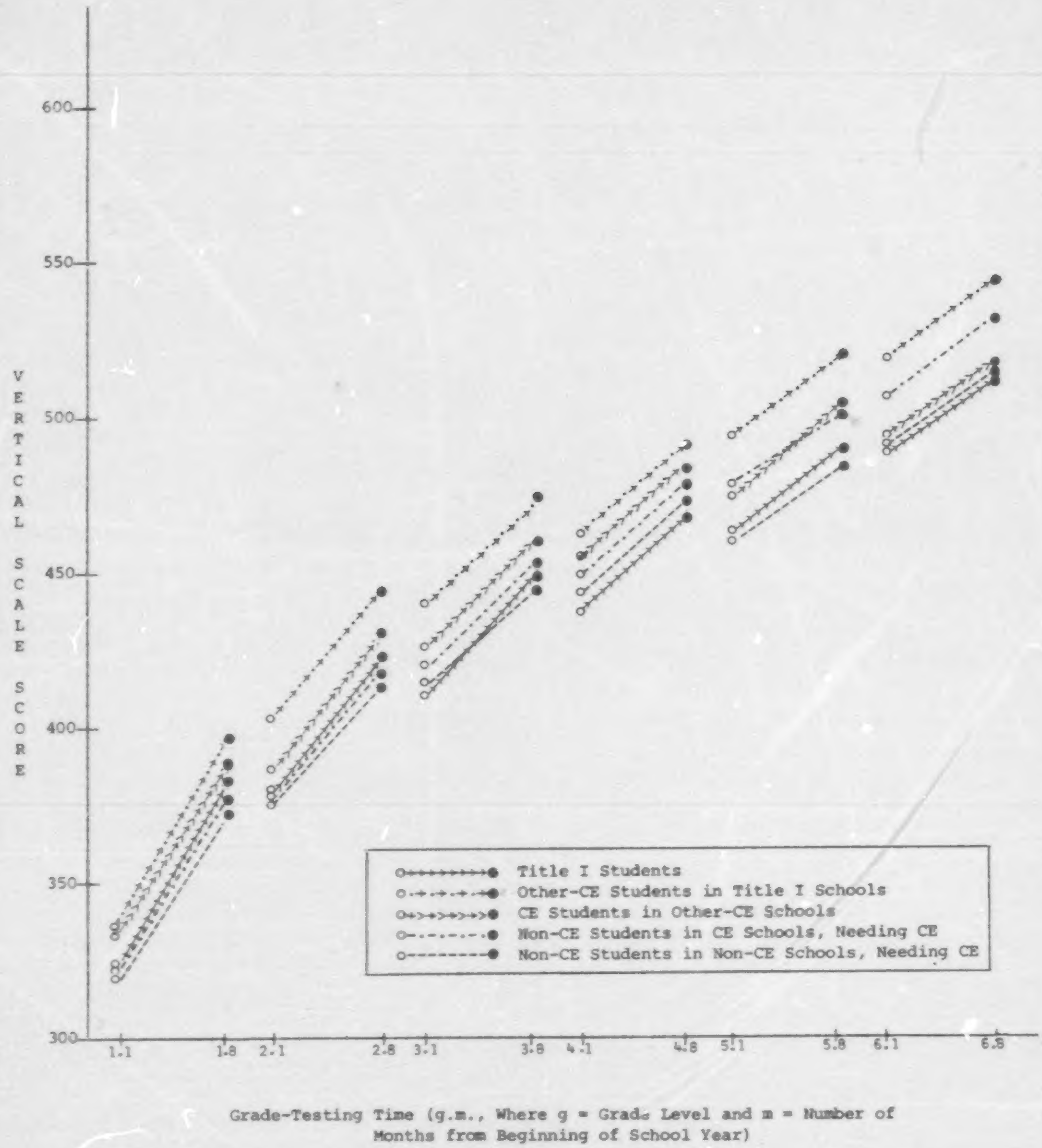

Figure 2-4

Mean CTBS Reading Scores in Fall and Spring for Three Groups of CE Students in Reading and Two Groups of Non-CE Students in Need of Reading CE

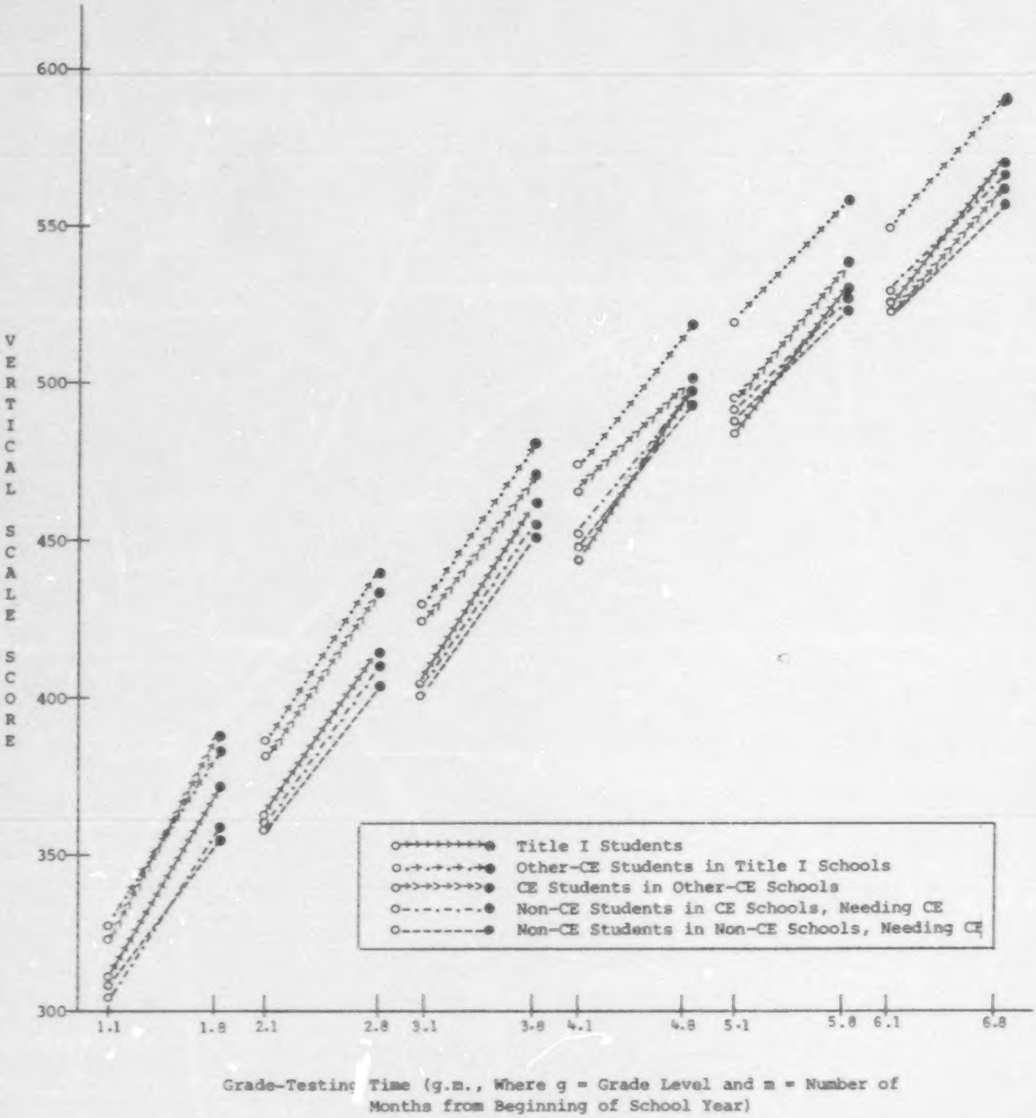

Figure 2-5

Mean CTBS Math Scores in Fall and Spring for Three Groups of CE Students in Math and Two Groups of Non-CE Students in Need of Math CE

Table 2-9 provides the group means of VSS gain, along with the F-tests for their differences among the groups. With the performance of the non-CE comparison groups as standards, positive CE effects are found for grades 1, 2, 3, and 6 in reading, and for all grades in math. The impacts of CE on learning are particularly noticeable for Title I students.

In addition, similar analyses of variance were also performed using standardized gain scores derived from the projected population distribution and the unweighted sample distribution. These analyses give very similar results as in the analyses with VSS gains. Their results are presented in Tables B2-4 and B2-5 of Appendix B2 for the two kinds of standardized gain scores, respectively. As may be seen from Table 2-9 and these two tables, there are no appreciable differences among the findings in the three sets of analyses.

Table 2-9

One-Way ANOVA of Fall-to-Spring Reading and Math VSS Gain for the Three Groups of CE Students and Two Comparison Groups of Needy Non-CE Students

CE Status	Gr.1	Gr.2	Gr.3	Gr.4	Gr.5	Gr.6
		Mean Reading VSS Gains				
Title I Students in Title I Schools	59.23	42.68	35.31	31.35	25.19	26.01
Other-CE Students in Title I Schools	59.59	41.31	30.56	28.46	23.89	26.85
CE Students in Other-CE Schools	54.18	45.96	34.55	29.36	27.88	21.01
Needy Non-CE Students in CE Schools	54.83	39.79	34.10	30.10	24.74	23.89
Needy Non-CE Students in Non-CE Schools	52.79	38.41	29.48	30.25	22.60	25.14
Total	57.08	41.75	33.81	30.30	24.91	24.83
F Statistic	8.77*	5.69*	6.02*	1.12	1.84	3.43*
		Mean Math VSS Gains				
Title I Students in Title I Schools	61.57	53.45	55.36	53.38	43.84	44.02
Other-CE Students in Title I Schools	57.20	53.97	49.80	45.26	37.68	39.18
CE Students in Other-CE Schools	62.46	54.36	46.32	33.88	42.18	36.18
Needy Non-CE Students in CE Schools	54.13	50.47	49.07	48.22	38.86	35.43
Needy Non-CE Students in Non-CE Schools	49.13	46.74	50.11	46.97	35.75	33.73
Total	56.34	51.46	51.30	47.86	39.44	37.43
F Statistic	22.54*	6.16*	7.00*	16.13*	6.08*	9.10*

Note. — Sample sizes for each group can be found in Table B2-4 of Appendix B2.

*Means differ significantly among the five groups at the .01 level.

Analyses of Variance by CE Groups and Judged Need for CE. In the last set of ANOVAs we introduce a control variable, teacher's judgment of each student's need for CE, in order to compare gains between CE and Non-CE students who are similar with respect to their need for CE. The interaction effects between CE status and judged need for CE are examined to determine if there are differential effects of CE according to student's need for it.

Table 2-10 presents the results of the two-way ANOVAs for reading and math. The effects of judged need are significant at grades 1, 2, and 5 for reading and in all grades for math. For both subjects, the non-needy students tend to have greater growth; the finding being more consistent for math. The effect of CE status, when need is taken into account, is significant in grades 1, 2, and 6 for reading and in all grades for math. From the means in Table 2-10, we can see that the Title I students who

Table 2-10

Average Fall-to-Spring VSS Gains in Reading and Math by CE Status and Teacher's Judgment of Need for CE[†]

CE Status	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	Needy	Not Needy	Needy	Not Needy	Needy	Not Needy	Needy	Not Needy	Needy	Not Needy	Needy	Not Needy
						Reading VSS Gains						
Title I Students in Title I Schools	58.03	63.93	42.78	42.41	36.01	32.37	31.36	30.70	25.52	24.33	26.83	24.38
Other-CE Students in Title I Schools	51.42	67.02	40.43	42.31	33.76	30.26	26.06	32.40	25.72	22.72	27.73	25.34
CE Students in Other-CE Schools	49.27	62.49	45.57	47.79	34.80	34.24	30.54	25.50	27.44	29.31	21.52	19.64
Non-CE Students in CE Schools	54.83	69.97	39.79	44.06	34.10	33.01	30.10	28.98	24.74	28.24	23.89	25.24
Non-CE Students in Non-CE Schools	52.79	70.44	38.41	44.53	29.48	35.38	30.25	29.99	22.60	29.57	25.14	25.28
Effect[*]:												
NEED	636.82**		21.38**		5.98		3.50		41.17**		0.01	
CE $\mid$ NEED	7.82**		4.32**		2.21		1.28		1.88		4.05**	
CE×NEED $\mid$ CE,NEED	8.08**		2.56		5.84**		2.93		2.88		1.41	
CE $\mid$ NEED,CE×NEED	5.87**		2.89		1.25		0.91		1.77		2.90	
						Math VSS Gains						
Title I Students in Title I Schools	59.70	66.93	51.11	59.19	55.04	56.89	53.47	53.80	44.82	40.28	44.12	44.88
Other-CE Students in Title I Schools	57.65	56.61	51.28	56.20	43.94	56.27	45.37	47.15	35.72	41.44	36.77	42.37
CE Students in Other-CE Schools	56.89	69.28	47.20	62.50	40.14	54.21	45.04	10.79	42.06	41.72	36.11	37.52
Non-CE Students in CE Schools	54.13	64.62	50.47	58.62	49.07	58.85	48.22	50.87	38.86	47.05	35.43	39.52
Non-CE Students in Non-CE Schools	49.13	62.93	46.74	54.94	50.11	63.49	46.97	51.96	35.75	45.89	33.73	43.70
Effect[*]:												
NEED	222.62**		130.00**		177.32**		6.67**		82.22**		30.53**	
CE $\mid$ NEED	14.58**		8.27**		15.40**		18.59**		4.34**		10.99**	
CE×NEED $\mid$ CE,NEED	8.37**		1.04		4.88**		16.97**		5.71**		3.39**	
CE $\mid$ NEED,CE×NEED	12.77**		5.73**		8.30**		25.21**		2.38		4.08**	

Note. — Sample sizes for each group and marginal means are provided in Tables B2-6 and B2-7 of Appendix B2.

[†] Teacher's judgment of need for CE was made in October-November, 1976. Students with missing data for CE status, teacher's judgment of need for CE, or test scores were excluded from the analyses.

[*] NEED = unadjusted differences between students who were judged to be in need of CE and those who were not so judged; CE $\mid$ NEED = differences among students of different CE statuses after adjusting for differences with respect to judged need for CE; CE×NEED $\mid$ CE,NEED = interaction effects between CE status and judged need for CE; CE $\mid$ NEED,CE×NEED = CE effects adjusted for both main effects of NEED and the interaction effects between CE and NEED.

[**] F-test is significant at the .01 level.

were judged needy frequently make larger gains than any other needy group. The interaction effects are more pronounced in math than in reading, but they are generally small, though significant in many cases.

An unreported one-way ANOVA by CE status, employing a reduced sample that contains only students judged as needing CE, generally confirms the findings based on the effects of CE conditional on judged need (see F-tests for CE/NEED in Table 2-10). One exception was found for grade 3, where the one-way ANOVA showed a significant CE effect ($F = 4.57$). This result, however, is consistent with the information contained in the two-way ANOVA that indicated a significant interaction between CE status and Need for CE. The interaction effects indicate that for students who were judged needy, CE students gain considerably more than non-CE students in Non-CE schools, while for students not judged as needy, there are little differences between CE and non-CE students.

Summary and Conclusions for the Analyses of Variance. In summary, comparisons with the growth of non-CE students who are judged as needing CE systematically disclose positive CE effects in both reading and math. In reading, the effects are evident in the lower three grades and in grade 6. In math, positive effects of different magnitudes are detectable in all grades. All significant effects are especially noticeable for Title I students. These findings are generally consistent over different kinds of gain scores. However, when compared with the non-CE students in general, the VSS gain fails to reveal clear patterns of CE effects, largely because of the problems of regression artifacts and differential growth rates. Analyses with standardized gain scores, on the other hand, show some significant impacts of CE, particularly in math, as compared with the relative gains of all non-CE students. Our overall conclusion is that Title I students achieve better than if they do not receive CE, but the improvement is not sufficient to offset the educational disadvantage they start with.

Analyses of Covariance for Constrasting Gains Between CE and Non-CE Students

The analysis of covariance (ANCOVA) is probably the most frequently used tool for the adjustment of pre-existing differences between groups in study designs that employ non-equivalent control groups. However, it has many pitfalls and its validity is often undermined because of the measurement errors associated with the covariates (see, for example, Porter, 1967; Cronback et al., 1976), so ANCOVA should be used with great care.

To supplement the results of the preceding ANOVAs, we also analyzed our data with the ANCOVA technique that incorporates Porter's method for adjusting the unreliability of covariates. Because our analyses indicated that the data mostly did not meet the basic assumptions for appropriate use of the ANCOVA model, and because the findings did not contradict or enlighten those of the previous section, we have elected to report these analyses in Appendix B3.

Comparison of Gains Conditional on Pretest Scores

One of the major problems in the evaluation of social programs is that of selection bias (Goldberger, 1972). However, when selection for participation in the program is strictly based on a cutoff score on a criterion measure (single variable or composite), the difficulty may be overcome, as an unbiased estimate of program effects is obtainable with regression methods (Barnow et al., 1978; Rubin, 1977). In this connection, Campbell (1969) has advocated the idea of a regression-discontinuity design. Sween (1971) investigated the assumptions of a family of models for this design, and proposed some solutions to the models. In theory, the regression-discontinuity model affords simple solutions, if the stringent selection rule is followed. In practice, selection based strictly on a single cutoff is rarely found. Most evaluation studies have to deal with situations where there is a high correlation between program participation and some criterion measure, but many data points violate the selection rule. Campbell refers to these as fuzzy cases of the regression-discontinuity design. There are not satisfactory solutions for this type of data, although many have been proposed (Campbell, 1974).

Nevertheless, in order to test the feasibility of implementing the regression-discontinuity model in the present study, we retrospectively collected achievement data from a number of schools that employed a test score as the primary criterion for the selection of students to receive Title I services. They provided us with the achievement scores in the spring of a preceding year or in the fall of the 1976-77 school year, whichever was used for the selection. In addition, they also stated the rules used for the selection so that we could verify them with their student participation data. Our preliminary analyses showed considerable discrepancies between the actual data and the selection rules. In fact, we could not find any set of data that was readily usable for the analysis with a regression-discontinuity model.

Because the schools invariably indicated that teacher recommendation was considered in the selection process even if it was not used explicitly as a criterion, we decided to add the data on teacher judgment of student's need for CE to the investigation. We then tried to develop a composite based on this data item and the test score in hope that the composite might efficiently separate CE from non-CE students within a school. We found one set of data that could be useful. However, the numbers of students in the CE and non-CE groups were not sufficient to allow proper estimates of the regression coefficients required in the model. The idea to implement this model was consequently abandoned.

Instead, we considered the applicability of other special regression models to our data for the purpose of assessing the effects of CE. As noted in Appendix B3, the within-group regressions of posttest score on pretest score are generally non-parallel for CE and non-CE groups. Under this circumstance, comparisons of predicted posttest score between groups can be useful when they are conditional on pretest achievement levels (Elashoff, 1969). This kind of comparison is also reasonable in the imperfect case of selection based on a covariate, particularly when there are considerable crossover cases in a range of covariate values (Rubin, 1977). Indeed, previous results indicated a substantial overlap of the distributions of pretest scores in the CE and non-CE subsamples. With these considerations, we applied multiple-regression models that allow heterogeneous within-group regression coefficients to our data for further examination of the effects of CE. The error variances needed in the t-test for the aforementioned conditional comparisons may be found in Zellner (1971).

Because the Title I guidelines imply that any student achieving at a level below the 50th percentile may be selected to receive services, we examined the CE status for students achieving in the 1st to 50th percentile range We found that between the 30th and 45th percentiles, both CE and non-CE groups are well represented. Hence, it was decided to make the conditional comparisons at four pretest achievement levels that correspond to the 30th, 35th, 40th, and 45th percentile ranks. Table B4-1 presents the raw scores and VSSs for these four achievement levels, as determined on the basis of the at-level norms.

Following the earlier distinctions among groups of non-CE students (those in CE and non-CE schools and those in need or not in need of CE), we performed four sets of parallel analyses, each using a different comparison group of non-CE students. In each analysis, the predicted posttest scores given a pretest score were computed separately from the regressions estimated with data for CE students, and for non-CE students in the particular comparison group. A t-test was obtained for the differences between the two predicted scores in order to evaluate the effects of CE. The four comparison groups involved in these analyses are listed in Table 2-11 and are described earlier in this chapter.

Because measurement errors in the regressor variable (pretest score in these analyses) frequently distort the underlying regression by introducing non-linearity into the model (Cochran, 1970; Lindley, 1974), we adopted both the linear and quadratic regressions in the present comparisons. Empirical study and theoretical considerations suggest that the departure from linearity due to fallible measures of the independent variables can often be represented by a quadratic or cubic component. Because of the high correlations among the self-generated variables, components of higher order than the quadratic did not prove useful. It suffices to comment that in any case, the linear component dominates the regression model.

Table 2-11

Predicted Reading and Math Posttest Scores for CE Students and Four Comparison Groups of Non-CE Students at the Pretest 'Cutoff' of the 35th Percentile Rank, Based on Quadratic Within-Group Regressions

CE Students and Comparison Groups	Predicted Mean Reading Score*	Predicted Mean Math Score*
Grade 1		
CE Students	389	377
Non-CE Students in CE Schools	401	385
Non-CE Students in Non-CE Schools	402	381
Needy Non-CE Students in CE Schools	384**	366**
Needy Non-CE Students in Non-CE Schools	384	362**
Grade 2		
CE Students	433	430
Non-CE Students in CE Schools	445	442
Non-CE Students in Non-CE Schools	439	437
Needy Non-CE Students in CE Schools	429**	424**
Needy Non-CE Students in Non-CE Schools	425**	421**
Grade 3		
CE Students	465	478
Non-CE Students in CE Schools	475	491
Non-CE Students in Non-CE Schools	472	491
Needy Non-CE Students in CE Schools	465	471**
Needy Non-CE Students in Non-CE Schools	459**	471**
Grade 4		
CE Students	488	512
Non-CE Students in CE Schools	502	525
Non-CE Students in Non-CE Schools	500	522
Needy Non-CE Students in CE Schools	489	510
Needy Non-CE Students in Non-CE Schools	489	509
Grade 5		
CE Students	525	556
Non-CE Students in CE Schools	537	569
Non-CE Students in Non-CE Schools	535	565
Needy Non-CE Students in CE Schools	525	551**
Needy Non-CE Students in Non-CE Schools	522	550**
Grade 6		
CE Students	548	580
Non-CE Students in CE Schools	559	588
Non-CE Students in Non-CE Schools	557	589
Needy Non-CE Students in CE Schools	549	574**
Needy Non-CE Students in Non-CE Schools	546	572**

Note. — Sample sizes, linear predictions, and t-test values can be found in Tables B4-2 and B4-3 of Appendix B4.

*The predicted posttest scores are obtained from the estimated within-group regressions of posttest on pretest.

**Predicted score for the CE students is significantly higher (at the .01 level) than that for the respective comparison group.

The results of these analyses are summarized in Table 2-11 for the 35th-percentile cutoff, while detailed results for comparisons at the four cutoffs are presented in Appendix B4 (Table B4-2 for reading and B4-3 for math). The most striking observation is the much lower predicted scores obtained with the regression based on data for CE students, than with regression based on data for non-CE students in general. This phenomenon is evident in all grades for both reading and math, and with either linear or quadratic models. Such negative findings should be interpreted cautiously. It is an indication that CE students are falling behind their non-CE peers in general, in the sense that the two groups have different growth rates. However, regression artifacts are expected to explain some of the differences. This is so because the same observed pretest score, which serves as the comparison point, likely represents a higher true score for the non-CE students, whose group has a higher mean achievement level. It is important to stress that this finding need not be considered evidence for ineffective CE.

The picture changes when more appropriate comparison groups are involved. As evidenced by the significant and positive t-values, analyses using needy non-CE students as comparison groups consistently show significantly positive effects of CE in grades 1 through 3 for reading, and in all grades but grade 4 for math. The findings with the linear and quadratic models are similar. One noticeable exception to this overall statement is that in reading, there are no differences in grade 3 between CE students and the group of needy non-CE students in CE schools. The findings of nonsignificant but positive effects of CE in grade 4 for math remain congruent with those in the previous ANOVAs, where significant differences in mean gains among the three groups of CE students and these two comparison groups were obtained. There it was found that Title I students on the average gained substantially more than needy non-CE students, but other-CE students did not show such benefits.

In conclusion, when comparison groups with similar achievement levels as CE students are employed, the present analysis approach presents a very clear picture of the effectiveness of CE. The results agree well with those in the previous analyses. In reading, CE tends to be effective in the lower three grades. In math, some effectiveness is shown in all grades. However, the benefits of CE are by no means great enough for its participants to achieve equally well as the non-disadvantaged non-CE students.

Comparison with Expected Growth Derived From Data for Non-CE Students

In our final approach to assessing the comparative effectiveness of CE in terms of reading and math achievement, we developed statistical models to describe the achievement patterns for non-CE students based on their pretest achievement and background characteristics. The resulting models were applied to the data for CE students to obtain approximations to the expected performances for them in the absence of CE services. The actual performances of CE students were compared with these expectations in order to evaluate the effects of CE. This approach in effect employs a form of value-added analysis (Bryk and Weisberg, 1976). Because of the similarities of this approach to aspects of other approaches already discussed, and because the results did not alter our basic conclusions on the effectiveness of CE, we present the method and report the findings in Appendix B5.

Summary of the Effects of CE on Reading and Math Achievement Growth

Integrating the findings obtained with different analysis approaches, we conclude:

- In general, CE is more effective in math than in reading. The findings of the ESAA evaluation (Coulson et al., loc. cit.) support the same conclusion. In reading, positive effects of CE are frequently observed in the lower three grades and in grade 6, but rarely or never in grades 4 and 5. The less effectiveness of CE in reading at grade 4 is similar to the finding of the Compensatory Reading Study (Trismen et al., loc. cit.). In math, positive effects of CE are evident in all grades, but the magnitude of effects varies with grade. In both reading and math, the significance of the effects of CE are more or less dependent on the analysis methods (i.e., comparison standards).

- Among the CE programs, positive effects of CE are often detected only for those involving Title I funds (though they may occasionally also involve other-CE funds). Evidence for positive effects of non-Title I CE programs is not observed very frequently.
- There is no marked evidence for negative effects of CE when the analyses employ appropriate comparison standards set on the basis of data for the non-CE comparison groups. However, it is clear that during the school year, CE students continue to achieve lower than their non-educationally-deprived peers.

PRACTICAL ACHIEVEMENT

In this section, we examine student practical-achievement growth in order to provide supplemental information on the educational development of students at grades 4 through 6, the grades in which the Practical Achievement Scale (PAS) was administered. As norms were not established for this test, the norm-referenced analyses were not performed. The rest of the four analytical approaches employed earlier in the analyses of basic skills were applied to evaluate the effects of CE on students' learning of practical skills.

Because the PAS has both reading and math items, and performance on it might be differentially affected by reading or math CE, in the ANOVAs and ANCOVAs, we examined the PAS gain scores for different groups of students defined in terms of their CE status in reading and in math, separately. The groups of students involved in these analyses were parallel to those employed in the reading and math analyses. Similar results were obtained with analysis groups formed either on the basis of CE status in reading or in math. We therefore combined the CE status in reading and math to define jointly the analysis groups in the multiple-regression analyses and the analyses with statistical models for the prediction of posttest performance.

When analysis groups were defined in terms of CE status in both reading and math, students who received Title I services in reading and/or math were considered as Title I students, while the rest of the CE students in reading and/or math were considered as other-CE students. In the classification of schools, those that provided neither reading nor math CE to their students were designated as non-CE schools, and all others as CE schools. Among the CE schools, those having Title I in reading and/or math were regarded as Title I schools, while others were regarded as non-Title I CE schools. Finally, to form the non-CE comparison groups, non-CE students who were judged to be in need of CE for reading and/or math were considered as (educationally) needy non-CE students.

Differences in Practical Achievement Growth Between CE and Non-CE Students

Because the results of analyses based on simple gain scores were similar when appropriate comparison groups were employed, we present only the results of analyses using standardized gain scores. The standardized gain scores were derived from the data for the entire sample. We first examined the differences among the six CE groups in reading and in math. Table 2-12 presents the mean standardized gain scores for the analysis groups and the results of the ANOVA tests. It shows that in grade 4, non-CE students on the average achieved greater gains than did the CE students. In contrast, CE students in grade 6 gained more during the school year. The differences among the groups were not significant in grade 5. These findings held regardless of whether CE status in reading or math was considered.

One possible explanation of the different findings among the grades is that non-CE students who are generally not educationally disadvantaged tend to learn the skills tested in the PAS earlier than the disadvantaged CE students. In order to examine possible differences in growth patterns between the groups of students with different educational needs, we plot, in Figure 2-6, the mean practical-achievement scores at the beginning and the end of the school year for groups of non-CE students in general and for specific subgroups of non-CE students who were judged as needing CE in reading and/or math. In comparison with the non-CE students in general, the slopes of the growth lines in

Figure 2-6 indicate a slightly lower growth rate for the needy non-CE students in grade 4, a similar growth rate in Grade 5, and then a greater growth rate in grade 6.

Because the same PAS was administered to students in the three grades, the larger gain scores in grade 6 for the needy non-CE students who tended to score lower in the PAS could be a result of ceiling effects of the test. That is, in grade 6, many non-CE students would have acquired the skills tested in the PAS at the beginning of the year, and there are not many items left to reflect what they have learned during the year. Consequently, their mean gain scores do not adequately represent their learning in the period. In grade 4, we have a different situation: because most students continue to learn the skills in the test and the disadvantaged students tend to be slower in learning the same skills, the CE students show a lower gain score than the non-CE students.

In light of these observations, we think that the findings from Table 2-12 may be largely explained by the different growth patterns between students of different educational needs and the ceiling effects of the test. If this is a plausible hypothesis, we would expect no differences in gain scores between CE students and the comparison group of needy non-CE students. We therefore performed a one-way ANOVA for the three groups of CE students and the two groups of needy non-CE students (in CE and non-CE schools) to examine their differences in gain scores. Indeed, no significant differences were found among these groups in the three grades. The results of these analyses are shown in Table B2-8 of Appendix B2. It may be concluded, then, that there is no evidence for noticeable effects of CE on growth in practical achievement.

Table 2-12

One-Way ANOVA of Fall-to-Spring Standardized Gain Scores in Practical Achievement by Reading and Math CE Status

CE Status		Reading CE			Math CE		
		Grade 4	Grade 5	Grade 6	Grade 4	Grade 5	Grade 6
Title I Students in Title I Schools	N	2,367	2,218	1,979	1,426	1,321	1,138
	Mean	-.02	-.01	.05	-.03	-.01	.03
Other-CE Students in Title I Schools	N	868	798	894	844	757	839
	Mean	.03	.04	.06	.00	.01	.05
CE Students in Other-CE Schools	N	609	576	613	366	392	450
	Mean	-.07	-.04	.08	-.11	-.02	.12
Non-CE Students in Title I Schools	N	6,448	6,772	6,863	7,413	7,710	7,759
	Mean	.03	-.02	-.00	.02	-.02	.01
Non-CE Students in Other-CE Schools	N	3,168	3,575	5,758	3,411	3,759	5,921
	Mean	-.03	.01	-.03	-.03	.00	-.03
Students in Non-CE Schools	N	1,887	2,151	2,455	1,887	2,151	2,455
	Mean	.05	.01	-.01	.05	.01	-.01
Total	N	15,347	16,090	18,562	15,347	16,090	18,562
	Mean	.01	-.01	-.00	.01	-.01	-.00
F Statistic		6.37*	2.12	7.46*	6.77*	.81	6.51*

* Mean standardized gain scores in practical achievement differ significantly among the six analysis groups at .01 level.

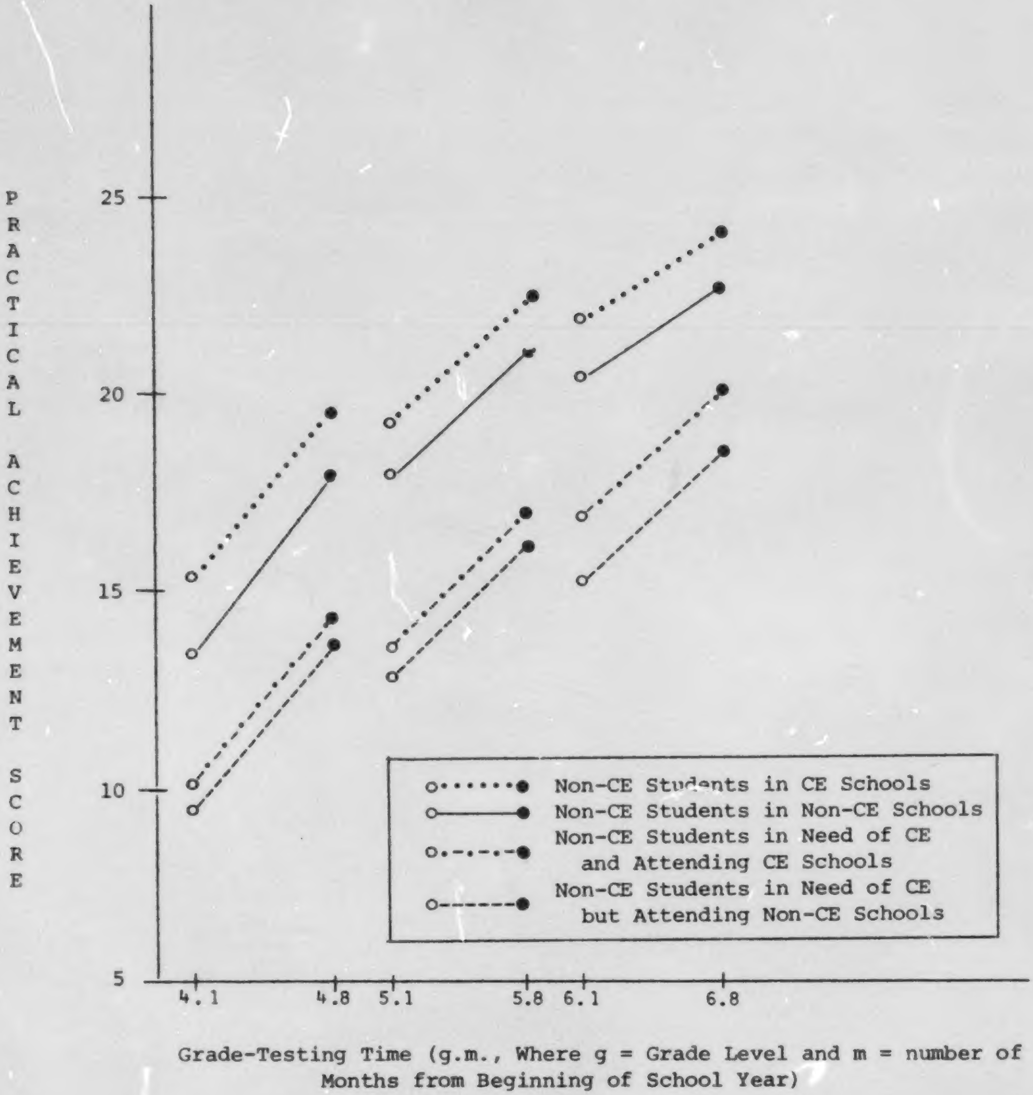

Figure 2-6

Mean Practical Achievement Scores for Four Groups of Non-CE Students in Reading and Math by Grade

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Analysis of Covariance for Contrasting Gains Between CE and Non-CE Students

Four sets of ANCOVAs, parallel to those explained in the analyses for reading and math achievement (see Appendix B3) were performed for the PAS scores. Again, a 30 percent random sample was selected to supply data for non-CE students when the six CE groups were analyzed. The reliability estimates used for the correction of fallible pretest scores range from .6 to 1.0 in steps of .10. As there were few interesting findings, we report the results in Tables B3-9 to B3-16 of Appendix B3.

Table B3-9 gives the mean practical-achievement scores in the fall and spring for all CE students and for two groups of needy non-CE students. It also shows that the assumption of homogeneous within-group regressions is not violated in any of the three grades when reading CE status is the basis for forming the analysis groups. However, the assumption is satisfied only in grade 6 when math CE status is considered. The adjusted group means and the F-tests for their differences are presented in Table B3-10, which indicates practically no significant differences among the groups in all three grades, as the estimated reliability for PAS is likely to be less than .9 (see Table 2-3 of Report 9).

The results of the other three sets of ANCOVAs are summarized in Tables B3-11 through B3-16. There are few consistent and significant findings, particularly within the reasonable range of reliability estimates (.7 to .9). The findings generally agree with those discussed in the preceding section.

Comparison of Gains Conditional on Pretest Scores

As in the similar analyses for reading and math achievement, four sets of parallel analyses, each using a different comparison group, were performed. The reader may refer to the earlier section that describes these analyses for details of the rationale and procedures. Complete results for these analyses are reported in Table B4-4 of Appendix B4, whereas the last column of Table B4-1 in the same Appendix gives the pretest scores corresponding to the four achievement levels at which the comparisons of expected posttest scores are made. Because the preceding analyses did not reveal substantial differences in PAS gains between Title I students and Other-CE students and because Title I students account for a large proportion (about two-thirds) of the CE students, separate analyses for Title I students are not performed.

For illustrative purposes, the results are also summarized in Table 2-13 for the cutoff at the 35th percentile. As in the analyses for reading and math, the most pronounced finding in this table is that CE students consistently fall behind at the posttest time when compared with the expected performance of non-CE students in general. Again, regression artifacts and the substantial pre-existing differences between the groups account for most of these differences in the expected posttest scores.

On the other hand, when subgroups of educationally needy non-CE students serve as the comparison groups, only a few significant differences were obtained: at the 30th and 35th percentile 'cutoffs,' the expected posttest score for CE students is significantly lower than that for the needy non-CE students in CE schools in grades 4 and 6. However, the differences were very small and the t-ratios are only slightly larger than the critical value for significance at the .01 level. Considering the large samples and the lack of significance at other comparison points (pretest levels), these results in effect support the previous findings that showed no appreciable effects of CE on the practical achievement growth of CE students.

Comparison With Expected Growth Derived From Data for Non-CE Students

Similar to the analyses for reading and math, two regression models were developed based on the data for non-CE students in order to estimate the expected posttest performance for CE students in the absence of CE intervention. The actual mean performance of the CE students was compared with the expectations derived from the prediction models to determine the effects of CE on the

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Table 2-13

Predicted Practical-Achievement Posttest Scores for CE Students and Four Comparison Groups of Non-CE Students at the Pretest 'Cutoff' of the 35th Percentile Rank, Based on Quadratic Within-Group Regressions

CE and Comparison Groups	Predicted Mean PAS Posttest Score*
Grade 4	
CE Students	13.6
Non-CE Students in CE Schools	15.8
Non-CE Students in Non-CE Schools	15.4
Needy Non-CE Students in CE Schools	14.0
Needy Non-CE Students in Non-CE Schools	13.5
Grade 5	
CE Students	17.7
Non-CE Students in CE Schools	19.4
Non-CE Students in Non-CE Schools	18.9
Needy Non-CE Students in CE Schools	17.9
Needy Non-CE Students in Non-CE Schools	17.6
Grade 6	
CE Students	20.2
Non-CE Students in CE Schools	21.5
Non-CE Students in Non-CE Schools	21.2
Needy Non-CE Students in CE Schools	20.7
Needy Non-CE Students in Non-CE Schools	20.5

Note. — Sample sizes, comparisons at other pretest 'cutoffs', t-values, and means for both linear and quadratic regression models can be found in Table B4-4 of Appendix B4.

*The predicted posttest scores are obtained from the estimated within-group regressions of posttest on pretest.

practical-achievement growth of its participants. The analysis procedures follow those in the reading and math analyses, as explained in Appendix B5.

The potential predictors and their selection into the regression models are indicated in Table B5-1 of Appendix B5. In the definition of the predictor variables, a student who was judged to be in need of CE in reading and/or math was considered as having need for CE. Similarly, a student who received CE in reading and/or math in 1975-76 was considered as having previous exposure to CE. The results of the cross-validations of the prediction models are summarized in Tables B5-2 and B5-3 of Appendix B5. The data indicate that the prediction models are adequate, and not particularly biased against specific groups of students.

Table B5-6 in Appendix B5 presents the results of these analyses. Inspection of the data in this table reveals little evidence for positive CE effects on practical-achievement growth. Only in grade 6 and when the achievement pattern for non-CE students in non-CE schools is used to approximate the performance of CE students in the absence of CE, we find that observed mean for CE students exceeds the expectation.

Summary of the Effects of CE on Practical-Achievement Growth

Putting together all the results of the analyses for the PAS scores, we conclude that positive effects of CE on the growth of practical achievement are not generally detectable. The limitation of a single-level practical achievement test may be partially responsible for this lack of finding.

ATTITUDINAL DEVELOPMENT - STUDENT AFFECTIVE MEASURE

Because there are no substantial differences in student affect scores at the beginning of the year, only the analyses with standardized change scores and analyses of covariance with pretest score as the covariate were performed in the evaluation of the effects of CE on students' attitudinal development. The Student Affective Measure (SAM) assesses student attitudes toward learning and school. It was not administered to the first graders in the fall. Hence, the present analyses do not involve grade 1.

Differences in Attitudinal Changes Between CE and Non-CE Students

The differences in attitudinal changes between CE and non-CE students were examined in terms of standardized change scores as computed from our sample data. Two sets of one-way ANOVAs were performed for the six CE groups; one in terms of reading CE, and one in terms of math CE. Table 2-14 presents the results of these analyses.

In terms of both reading and math CE status, we found that changes in attitudes of CE students, Title I students in particular, are more favorable relative to the changes in attitudes of non-CE students in grade 6. These findings can not be interpreted easily considering that, for all groups of students in this grade, the attitude scores tend to decrease at the posttest (see Table B3-17 of Appendix B3). Our data suggest a smaller decline for Title I students who start with higher scores at the beginning of the school year. Thus, Title I students in grade 6 tend to maintain a relatively more positive attitude than non-CE students, but generally do not show an absolute improvement in attitude.

The differences in attitudinal changes among the six CE groups are mostly insignificant in grades 3 through 5. In grade 2, student affect scores tend to increase for all groups of students, and non-Title I CE students appear to show a greater improvement in their attitudes relative to Title I and non-CE students. The patterns of these inconsistent results across grades do not lend themselves to obvious interpretations. We suspect that the unproven validity of the attitudinal measure in the elementary schools makes it difficult to obtain meaningful results.

As it is likely that the higher scores for CE students largely reflect a tendency for students from families of low socioeconomic status to respond in a more socially desirable manner (see Report 5), we specifically compared the attitudinal changes between CE students and the groups of educationally needy non-CE students. These comparisons again did not reveal appreciable differences except in two cases. In grade 2, changes for reading CE students (particularly for other-CE students in Title I schools) tend to be more favorable in comparison with needy non-CE students in CE schools. In grade 6, math Title I students show more favorable changes relative to those for needy non-CE students. The results of these additional analyses are summarized in Table B2-9 of Appendix B2.

The conclusion is that there are no consistent and substantial effects of CE on the development of student's attitude to learning and school.

Analyses of Covariance for the Examination of Attitudinal Changes for CE and Non-CE Students

Parallel to the ANCOVAs in reading and math, four sets of ANCOVAs were performed for student affect scores. The mean pretest and posttest scores for the six CE groups in reading and in math are

Table 2-14

One-Way ANOVA of Fall-to-Spring Standardized Change Scores in Student Affect by Reading and Math CE Status

CE Status		Grade				
		2	3	4	5	6
		Reading CE Status				
Title I Students in Title I Schools	N	2,748	2,784	2,206	2,097	1,867
	Mean	.02	-.00	-.00	.02	.08
Other CE Students in Title I Schools	N	869	826	828	753	847
	Mean	.15	-.02	-.04	-.03	.03
CE Students in Other-CE Schools	N	651	593	586	555	584
	Mean	-.02	.00	-.00	.11	.06
Non-CE Students in Title I Schools	N	5,512	5,609	6,163	6,538	6,597
	Mean	-.00	-.00	.00	-.01	.01
Non-CE Students in Other-CE Schools	N	2,670	2,731	3,061	3,492	5,597
	Mean	-.03	.01	.01	.02	-.02
Students in Non-CE Schools	N	1,766	1,812	1,846	2,082	2,405
	Mean	.05	.02	.01	-.01	-.02
Total	N	14,216	14,355	14,690	15,517	17,897
	Mean	.01	.00	.00	.00	.01
F Statistic		4.97*	.33	.34	2.86*	4.50*
		Math CE Status				
Title I Students in Title I Schools	N	1,500	1,651	1,324	1,268	1,057
	Mean	.00	.01	-.02	.02	.16
Other-CE Students in Title I Schools	N	725	679	799	704	807
	Mean	.05	.04	-.04	.06	-.01
CE Students in Other-CE Schools	N	279	353	353	375	432
	Mean	.13	-.04	.01	.06	.15
Non-CE Students in Title I Schools	N	6,904	6,889	7,074	7,416	7,447
	Mean	.02	-.01	.01	-.02	.01
Non-CE Students in Other-CE Schools	N	3,042	2,971	3,294	3,672	5,749
	Mean	-.04	.01	.01	.03	-.02
Students in Non-CE Schools	N	1,766	1,812	1,846	2,082	2,405
	Mean	.05	.02	.01	-.01	-.02
Total	N	14,216	14,355	14,690	15,517	17,897
	Mean	.01	.00	.00	.00	.01
F Statistic		3.37*	.92	.54	2.53	10.69*

* Mean standardized change scores in student affect differ significantly among the six analysis groups at .01 level.

presented in Table B3-17 in Appendix B3, along with estimates of within-group regression coefficients. As indicated in this table, the assumption of homogeneous within-group regressions is satisfied in all cases. Inspection of the means shows that the changes in affect scores from fall to spring tend to be small for all groups. Sometimes, the means decline at the end of the school year, especially in grades 5 and 6. Table B3-18 in Appendix B3 gives the adjusted group means and the F-tests for their differences. The results are quite similar to those obtained with the ANOVAs earlier. In grades 2 and 6, CE students consistently show higher adjusted means than those for non-CE students in CE schools. Other findings are mostly insignificant or do not demonstrate consistent patterns of differences among groups.

There are few interesting findings in the other three sets of ANCOVAs. They are also presented in Appendix B3 (Tables B3-19 through B3-24).

Summary of the Effects of CE on Attitudinal Change

There is slight evidence that CE students maintain more favorable attitudes toward learning during the school year as compared with non-CE students in CE schools. Considering the inconsistent findings across grades, potential response biases, and the generally low reliabilities of the SAM (see Report 9), we conclude that there is no evidence for substantial effects of CE on the attitudinal development of students.

SUMMARY OF FINDINGS

We now provide a brief summary of the findings presented in this chapter:

- Five different analytical approaches were applied to examine the effectiveness of CE on student achievement growth in basic skills. CE was found generally effective in accelerating the achievement growth of its participants, though the findings vary slightly with the analytical methods used. The positive impacts of CE on learning were observed more frequently in math than in reading. In reading, CE was effective primarily in the first three grades, and also in grade 6; whereas in math, CE was shown to be more or less effective in all grades. The positive effects of CE on achievement growth were particularly noticeable when it involved Title I programs. As evidence for positive effects indicates that CE students achieve better than expected of them in the absence of CE services, the present results suggest that CE has helped in arresting and sometimes narrowing the anticipated (widening) achievement gap between them and their non-disadvantaged peers.

- There are few interesting findings concerning the effects of CE on students' achievement growth in practical skills. Based on the measures of the Practical Achievement Scale (PAS), the patterns of achievement gains over the grades differ between groups of students with different educational needs. However, such differences may largely be attributable to the ceiling effects of the test. Comparisons with specific subgroups of non-CE students having similar educational needs, however, show no differences in PAS gains between the CE and non-CE groups. We thus conclude that there is little evidence to indicate the effectiveness of CE on the practical-achievement growth of its participants.

- Changes in student affect during the school year tend to be small for CE as well as non-CE students. Sometimes the mean affect scores decline at the end of the school year, particularly in the upper two grades. Although some evidence shows favorable effects of CE on the development of students' attitude in grades 2 and 6, the findings are not consistent with other grades. We conclude that CE does not have a positive effect on the development of learning attitudes.

CHAPTER 3.
THE EFFECTS OF INSTRUCTION ON THE ACHIEVEMENT GROWTH OF COMPENSATORY-EDUCATION STUDENTS

The primary function of Compensatory Education (CE) is to provide its participants with supplementary instruction to improve their achievement. In this chapter, we begin our inquiry into how CE can help the educationally deprived students achieve better by examining the effects of instruction on achievement. We concentrate on the amount of instruction as measured by time and leave the study of other instructional dimensions to Part II of this report.

Assuming the validity of the fan-spread hypothesis (which assumes that achievement differences between groups increase over time in proportion to the increase of standard deviations over time), we first applied Campbell's treatment-effect correlational method to determine if total amount of instruction received has any positive effect on achievement. The correlational analysis reveals that there is a positive but small relationship between achievement growth and amount of instruction. As a byproduct of examining this relationship separately by patterns of instructional services, we find that students who start with lower achievement receive greater amounts of services with an emphasis on instruction by special teachers and in small groups, while students who start higher receive lesser amounts and with less emphasis on such special instruction.

In order to compare the effects of the different kinds of instruction, we divide the total instruction into three components: regular instruction, special instruction (characterizing the services received by CE students), and tutor/independent work. Multiple-regression and structural-relation models are then employed to examine the effects of these three kinds of instruction. The analyses show that amount of special instruction in general does not have a positive effect on achievement, regardless of whether our analysis is concerned with all elementary students or is confined to a sample of disadvantaged students. By comparison, amount of regular instruction tends to be positively related to achievement growth. As CE students generally received more special instruction and less regular instruction (with a net total of more instruction) than non-CE students, we conclude from these findings that the achievement of CE students is unlikely to be accelerated as a result of receiving special instruction (instruction by special teaching staff and in small groups). Whatever positive impact that CE has demonstrated so far remains unexplained. We suspect that fruitful search for an explanation of how CE works may require the examination of the achievement process over a longer period, and better data on what takes place in the special instruction (rather than on time alone).

In Chapter 2 we were concerned with the effects of CE on the achievement growth of students. We wanted to determine if CE participation itself had a demonstrable effect on educational development. Although such determinations are important for a comprehensive evaluation of CE, it is important to look beyond mere participation to the instructional services the students receive, and then to relate those services to achievement growth. This more penetrating investigation is begun in the present chapter. The goal of such study is, of course, the prescription of particularly effective services so that the educational processes called 'CE' can be improved.

We will examine first the relationship between achievement growth and instructional services received during the school year by comparing the correlation between services and fall achievement with that between services and spring achievement. The method is commonly referred to as a treatment-effect correlational approach. The analysis is applied to the entire sample, disregarding student CE status, because it considers instructional services as the primary treatment that can affect achievement. The differences in achievement-service correlation between fall and spring is related to the partial regression coefficient for services when the (standardized) posttest score is regressed on services and the (standardized) pretest score, with pretest-posttest correlation as a factor for correcting the unreliability of pretest scores. Therefore, this approach in effect assesses the relationship between services and adjusted achievement growth. (The use of pretest-posttest correlation as an estimate of the pretest reliability is appropriate if, without special intervention, individual differences in achievement tend to increase over time in proportion to the increase of standard deviation, the fan-spread phenomenon.)

Second, the multivariate regression analyses are employed to determine the relative importance of student characteristics (including initial achievement), and amount of instruction in explaining achievement growth. Emphases will be placed on the technique of commonality analysis in which the proportion of variance that is explained by the predictors is decomposed into components that are unique to various sets of predictors and that are common to two or more sets. In the absence of a specific causal model for the relation between achievement and the background and educational variables, the commonality analyses may be used as a crude tool to assist us in making inferences about the relative usefulness of different sets of variables in predicting achievement growth.

Finally, we will test some structural models that relate student characteristics, CE status, and amount and kind of instruction to achievement. Measurement models that are important for dealing with fallible measures of achievement and student background will also be incorporated into these models. In this way, the findings from the traditional regression approach, which suffers from unreliability of predictor variables and lack of causal connections, are complemented by those obtained with a more rigorous approach that examines structural relations as well as measurement errors.

Our analyses generally reveal a small role for the amount of instruction in explaining achievement growth. Somewhat discouragingly, we also find that more special instruction which characterizes the services received by CE students generally does not result in greater growth. The understanding of how CE can help improve participant achievement requires further research.

THE MEASUREMENT OF INSTRUCTIONAL SERVICES

Every student receives a wide variety of instructional services each day, ranging from planned exercises to fortuitous enlightening experiences. Therefore, in a study like this, some fundamental decisions must be made about how instructional services will be defined and measured. The approach of the study was based on the promising approaches of many recent studies (the Compensatory Reading Study, Trismen et al., 1975; the ESAA Evaluation, Coulson, Ozenne, Hanes, Bradford, Doherty, Duck and Hemenway, 1977; and the Instructional Dimensions Study, National Institute of Education, 1977b).

The best thinking at the time was that instructional services can most effectively be assessed (by survey methods) in terms of time, instructor and group size. We developed two instruments (SPAR and SPAM, see Chapter 1) to capture differences on all three dimensions, so that for each student we could estimate the number of hours per year of instruction received from different kinds of instructors and in groups of different sizes. These data were obtained separately for reading and math. In this chapter, we concentrate on instructional services as measured by number of hours of services received.

The study has also used another index of service that weights the number of hours differentially according to the intensity of labor involved in each arrangement and takes into account the usage of equipment and materials. Although this index is expressed, perhaps misleadingly, as standard resource dollars (see Technical Report 6), it should be regarded simply as a transformation of the variables for instructional time in order to reflect the intensity as well as the quantity of services. This derived scale for services is analyzed only in the treatment-effect correlational approach.

In the correlational analyses we employ total hours of instruction received, without separate consideration of differences in instructor or group size. In other analyses, the hours of instruction received in each of the ten service components of the student attendance records are combined into three composite indicators to reflect differential emphases on types of services delivered. Based on earlier findings that differences between CE and non-CE students in services received are largely in the small-group (1-6 students) instruction, special-teacher instruction, and assistance by aides, those service components were combined to form an indicator of 'special' instructional services (H_S = hours of special services). The remaining service components are divided into two sets to form additional composite indicators: one for hours in medium- and large-group instruction by regular classroom teachers (H_R = hours of regular services), and one for independent work with tutors or in study (H_I = hours of tutor/independent work). The three composites are defined separately for reading and for math.

Aside from their ability to discriminate between CE and non-CE students, the three composites are selected for use in the regression and structural-model analyses on the basis of results obtained in our preliminary analyses. The preliminary analyses showed that the component items within each of the composites tend to share similar regression coefficients (same sign in particular). The regression analyses that include the ten original instructional components and those employing the three composites result in almost identical coefficients of determination (multiple R^2), indicating that differential weighting of the components within a composite produce negligible contributions to the explanation of achievement variation. In fact, use of the total hours of instruction doesn't even noticeably reduce the proportion of variance in posttest scores that is explained by the model (for a similar finding, see Report 7, where the standard-resource dollars index for each component instead of number of hours is investigated).

In addition to these preliminary results, consideration of some estimation problems that may be caused by excessive use of variables with badly skewed distributions also motivated us to abandon the ten instructional items in favor of the composites. Explicitly, use of predictor variables that have very uneven distributions (such as the individual service items which have zero values for large proportions of students because they tend to represent alternative forms of instruction) can lead to unstable estimations and distorted inferences. By summing items that are likely to be substitutes for one another, we can often alleviate the extreme skewness.

When the total number of hours is used as a sole measure of services, its relationship with achievement growth may differ for different patterns of service. In order to address this problem, we further define six patterns of instructional service from the three composites, separately for reading and math. For each student, the yearly hours of instructional services received (corresponding to each of the three composites) were divided by the total hours received per year (H_T = sum of the ten service components) to obtain the proportions of services received in each of the three categories. At each grade, the distribution of each of the three proportions was dichotomized at its projected population value (see Table C1-1 in Appendix C1 for the values), so that each student's indicator was described as being above the population mean (+) or below it (−). Of the eight potential patterns of service (total number of permutations of three +'s and/or −'s), two occur only in rare cases where all three proportions are equal to the population values. Therefore, only six patterns are employed in the analyses to control for differences in the service configurations. The rationale for defining the service patterns in this way is that for the same amount of instruction, differential emphases of the three kinds of instruction may lead to different effects.

In passing, it should be noted that not only do the hours of services received in various service components not completely reflect the quality of services, they also do not show if the services are directly aimed at improving the basic skills measured by the achievement tests administered. The issue of effects of curriculum overlap with test content on achievement scores is not addressed here for lack of necessary information. Our goal is to ascertain the role of educational services in improving the basic-skill achievement of CE students. The achievement tests were selected so that they measure basic skills that are common to a variety of curricula.

It should also be noted that we do not have accurate information for adjusting any potential effects of different time intervals between the pretest and posttest. However, there was no evidence that the schools had deliberately altered the testing dates, and therefore substantial differences in time intervals were not expected. The relationship of instructional services and educational practices with educational development will be examined further in later chapters, especially in Part II of this report.

INSTRUCTIONAL SERVICES AND ACHIEVEMENT GROWTH — A CORRELATIONAL APPROACH

Campbell (1971) suggested a correlational approach for determining the presence of a treatment effect by comparing the correlations between the treatment-group membership and the criterion measure at the pretest and the posttest time. Under the fan-spread hypothesis and assuming no treatment effect, the two correlations should be equal, and therefore a significant difference between them would indicate an effect. The idea of this technique can be traced back to Woodrow (1939) and, in fact, it has been employed to evaluate the effects of treatments of a quantitative nature.

The method is easy to understand, and has been successfully applied to continuous treatment variables by Coulson (1972) in the initial screening of program variables for inclusion in the reanalyses of Headstart evaluation data.

In the current context, amount of services constitutes an educational treatment that varies continuously, and the achievement score serves as a criterion measure. We have chosen this simple correlational method as our first approach to the investigation of the effects of instructional services on achievement growth. Hotelling's (1940) t test is applied to the difference in correlations in order to detect the effects of treatment.

Specifically, if one considers CE as an 'all-or-none' treatment, the comparison of treatment-posttest correlation with treatment-pretest correlation leads to a comparison of the mean standardized gain scores between the treatment and no-treatment groups. In reality, the kind of treatment varies extensively within CE programs and so does the amount of treatment. Stemming from a belief that an increase in instructional services results in the acceleration of learning, the intention of CE programs is to provide supplementary instruction to educationally disadvantaged students in order to improve their achievement. It follows that the concept of 'treatment' (i.e., instructional service) in CE is very much a continuous one.

An extension of the analysis of standardized gain scores to this situation would be to compare the correlations between the continuous treatment variable and the outcome measure for the students at the pretest and posttest time. As greater amounts of services are received by CE students who are generally lower achievers in comparison with non-CE students, we would expect the correlation between achievement and amount of services to be negative at the pretest time. However, if the relative achievement standings of low-achieving students are improved as a result of additional services provided to them, the negative correlation will decrease (become smaller in size) or even become positive at the posttest time.

Conceptually, unless through its association with differences in initial achievement status, student characteristics, instructional services, and other program characteristics (to be studied in Part II of this report), the mere labeling of students as CE or non-CE students cannot account for differential growth between them. If we are to believe that supplementary services can really help CE students attain greater achievement and thereby justify CE programs, we first have to confirm empirically the idea that more services lead to greater growth.

In order to control for differential effects among the different service patterns, the analyses are reported for each of the six subsamples corresponding to the six patterns of service described earlier. One may object to such analyses on grounds that the correlations may be reduced due to

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the restricted ranges of variables. But because the patterns are defined in terms of proportional distributions of the total hours of services over the three sets of service items rather than the hours of service per se, within each pattern, total hours of services still vary widely.

There is a possibility that the groups with emphasis on instruction in small groups and by special teaching staff would have restricted test scores on the basis of previous findings showing that these services are generally provided to CE students. Even if this is the case, the analysis should not be invalid because our interest is not in the size of the correlation, but in the differences between correlations. Moreover, our results indicate that there remains considerable variation in total hours of services, pretest scores, and posttest scores for each subsample of service patterns. (Nevertheless, the results should be interpreted with consideration of the possible effects of restricted ranges, as the variances do decrease in some groups.)

Table 3-1 presents the correlations between total hours of instructional services and pretest and posttest achievement for each of the six service patterns, and for all patterns combined. Hotelling's t statistic for the significance of the difference between each pair of (*non-independent*) correlation coefficients is also provided in the table. As we are interested in the direction of the change in correlations, a value of + 2.33 for the t statistic indicates significant (at the .01 level) and positive effects of instructional services on achievement.

In the interpetation of the findings from Table 3-1, the reader should be reminded that the number of hours of services does not reflect the quality or content of instruction. As a supplement, parallel analyses are performed using the standard-resource-dollar index for services, which takes into account the intensity of services by assigning higher values to instruction received in smaller groups and from teachers of higher qualifications. However, this alternative index still does not measure directly the quality of services, and the pattern of its correlations with achievement remains similar to that using number of hours as the index. Similar results of these additional analyses are summarized in Table C1-2 of Appendix C1.

Earlier analyses revealed that CE students received more hours of instructional services with few exceptions (see Technical Report 5) and that they generally received services of higher intensity (see Report 6) than did their non-CE counterparts. Hence, if the present findings support the contention that more hours of services (or more intensive services) result in greater achievement growth, we can infer that CE students who receive more services are likely to have greater growth than their peers who receive less services.

The results of our analyses can be summarized in four different ways, and it is enlightening to consider each.

Services and Achievement Growth by Grade. For both measures of instructional services and in both reading and math, analyses with the total sample consistently show positive overall effects in the upper three grades. The findings are inconsistent for grade 1 in reading and for grade 3 in math when different measures of services are employed. But the relationships between achievement growth and instructional services are mostly positive for these two grades. By contrast, no significant effects of instructional services are obtained for the total sample in grade 2.

Services and Achievement Growth by Reading and Math. Analyses with the total sample and with the subsamples by instructional patterns reveal similar relationships between achievement growth and instructional services for reading and math. Among all subsample analyses in the six grades, 15 positive relationships for reading and 17 for math are found to be significant (at the .01 level), when number of hours of instruction is used as the measure. In terms of the standard-resource-dollar index, the results show eight significances for reading and ten for math. As there are 36 analyses in each set, these data give support for a positive relationship between services and growth only in about one-half or fewer of the cases. The more frequent occurrences of significant and positive relationships in the analyses of the total sample are probably artifacts of the large sample sizes.

Table 3-1

Changes in Correlations Between Achievement and Number of Hours of Instruction Received During the Year, for Subsamples of Students Classified by Pattern of Instructional Services

Grade	Correlation Between Amount of Services and Pretest/Posttest Achievement	Subsamples by Pattern of Instructional Services*						Total Sample
		+--	-+-	++-	--+	+-+	-++	
	Reading Achievement and Services							
1	Pretest	.01	-.01	.11	.06	.04	-.07	.04
	Posttest	.06	.02	.12	.12	.07	-.01	.08
	t_{diff}**	4.34	1.65	0.29	3.90	1.85	3.65	6.73
2	Pretest	-.03	.02	.09	-.01	-.06	.07	.01
	Posttest	-.05	.07	.09	-.01	-.03	.04	.02
	t_{diff}**	-2.05	4.05	-0.10	0.11	2.81	-1.55	1.42
3	Pretest	-.09	-.01	-.07	-.03	-.16	-.04	-.08
	Posttest	-.11	.02	-.10	-.00	-.16	.02	-.07
	t_{diff}**	-1.73	2.10	-1.64	1.55	0.02	5.28	2.16
4	Pretest	-.10	-.10	-.13	-.13	-.09	-.21	-.17
	Posttest	-.08	-.09	-.22	-.13	-.08	-.16	-.16
	t_{diff}**	2.76	0.27	-4.24	-0.42	1.05	4.92	2.89
5	Pretest	-.09	-.22	-.22	-.08	-.15	-.18	-.17
	Posttest	-.07	-.18	-.20	-.06	-.14	-.15	-.15
	t_{diff}**	3.69	3.07	1.38	2.41	0.38	2.57	5.64
6	Pretest	-.13	-.26	-.28	-.08	-.13	-.26	-.19
	Posttest	-.10	-.23	-.23	-.07	-.13	-.26	-.16
	t_{diff}**	5.47	3.24	3.69	1.00	1.02	0.28	6.59
	Math Achievement and Services							
1	Pretest	-.04	-.02	.05	-.07	.08	.01	-.03
	Posttest	.00	.05	.10	-.05	.14	.05	.01
	t_{diff}**	3.17	4.19	2.05	1.73	2.73	2.52	6.59
2	Pretest	-.03	-.12	-.12	.11	.08	-.13	-.04
	Posttest	-.09	-.09	-.05	.12	.05	-.00	-.03
	t_{diff}**	-4.60	1.46	2.40	0.72	-1.44	7.63	0.68
3	Pretest	.02	-.05	-.03	-.00	-.03	-.01	-.04
	Posttest	.02	-.03	-.14	.07	-.02	.00	-.03
	t_{diff}**	0.17	1.48	-4.30	5.78	0.56	1.06	2.47
4	Pretest	-.06	-.07	-.11	.02	.03	-.17	-.10
	Posttest	-.03	-.02	-.02	.03	.07	-.11	-.06
	t_{diff}**	2.37	2.56	3.75	1.38	2.18	4.56	7.44
5	Pretest	-.02	-.12	-.17	-.12	.01	-.18	-.12
	Posttest	-.01	-.09	-.14	-.06	.02	-.13	-.09
	t_{diff}**	0.86	1.85	1.36	5.56	0.84	4.00	6.41
6	Pretest	.01	-.06	.01	-.05	.03	-.12	-.05
	Posttest	.03	-.02	.07	-.02	-.00	-.12	-.03
	t_{diff}**	2.70	2.76	2.70	2.99	-1.69	-0.07	4.15

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*The hours of instruction received during the 1976-77 school year were employed to form six patterns of instructional services. The instructional services were grouped into three kinds: regular instruction (by classroom teachers in groups of 7 or more), special instruction (by special teachers, paid aides/assistants, or by classroom teachers in groups of 1-6), and tutor/independent work. Three variables representing the proportions of hours of instruction received in each of the three kinds of services were created and then each was dichotomized at the corresponding estimated population value. Because the proportions sum to 1.0, six mutually exclusive patterns of services were obtained on the basis of three dichotomies, excluding the rare cases where each proportion was equal to its respective cutoff (mostly due to roundings). In the Table, a '+' indicates the proportion is above the cutoff, while a '-' indicates a value below the cutoff. *The instructional patterns are represented by the three indexes of '+/-' for regular instruction, special instruction, and tutor/independent work (arranged from left to right).* For example, the pattern '+--' indicates that the proportion of regular instructional time is above its cutoff, while the proportions of special instruction and tutor/independent work are below their respective cutoffs.

**Hotelling's t statistic for the difference between the pair of correlations.

Services and Achievement Growth by Measure of Services. With 32 positive associations for hours of service and only 18 for standard-resource-dollar index in the subsample analyses, it appears that number of hours is a more sensitive indicator of growth-related services. However, no contradictory findings between the two measures of service are apparent.

Services and Achievement Growth by Instructional Patterns. Combining the results across measures of service and grades, significances of positive relationships are found most frequently for the service pattern that represents high proportions of special instruction and independent work, but a low proportion of regular instruction ('– + +' in the table). The pattern for which significances are found least frequently is one that represents low proportions of special instruction but high proportions of the other two kinds of instruction ('+ – +' in the table).

Additionally, it may also be observed from Table 3-1 that, in reading, the correlations between the pretest score and amount of service become more negative in the upper three grades. There is a similar but less clear trend in math. This observation suggests that there is a tendency to allocate services according to student's need in the upper grades, especially in reading.

An added benefit of these correlational analyses by service pattern is that the descriptive data allow us to examine the relationship between achievement of students and the pattern of services they receive. We present the mean pretest scores, VSS gains, and amount of services received for each group of students associated with the six service patterns in Tables C1-3 and C1-4 (in Appendix C1) for reading and math, respectively. The data in these tables are also displayed graphically in Figures 3-1 and 3-2.

From these figures, we find that students with low test scores tend to receive services that are characterized by a high proportion of special instruction (patterns '+ + –' and '– + –'). With some exceptions in the first two grades, students receiving services in these patterns tend to receive more total hours of services. In contrast, students with high test scores generally receive services that are characterized by a low proportion of special instruction (patterns '+ – +' and '– – +'). These latter groups of students also tend to receive fewer total hours of services. Furthermore, the standard-resource-dollar index of total services is highest for the pattern that heavily emphasizes special instruction ('– + –), and lowest for the patterns that de-emphasize special instruction ('– – +' and '+ – +').

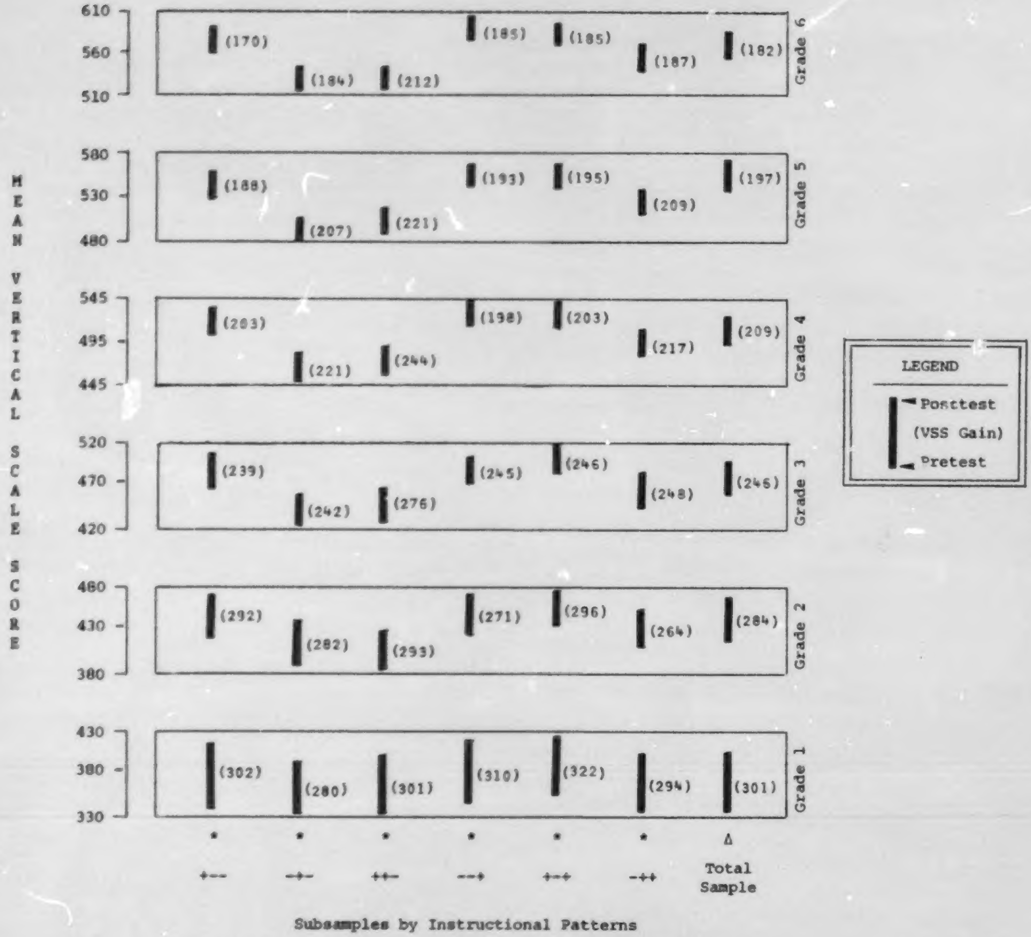
Inspection of the length of the vertical lines connecting the pretest and posttest means, however, shows no clear tendency for students in any particular service pattern to have a greater growth rate. It seems that average raw gains (in VSS units) are not very sensitive to the effects of amount of instruction, perhaps because preexisting differences in factors that affect learning have not been adjusted properly.

In summary, the analyses of treatment-effect correlations reveal that:

- A positive and significant but quite small relationship exists between achievement growth and amount of services received. That is, with pretest differences controlled, slightly greater growth results from receipt of more services.

- The positive relationship between achievement growth and services is evidenced more frequently when number of hours of instruction is employed as the index for total services than when the standard-resource-dollar index is used.

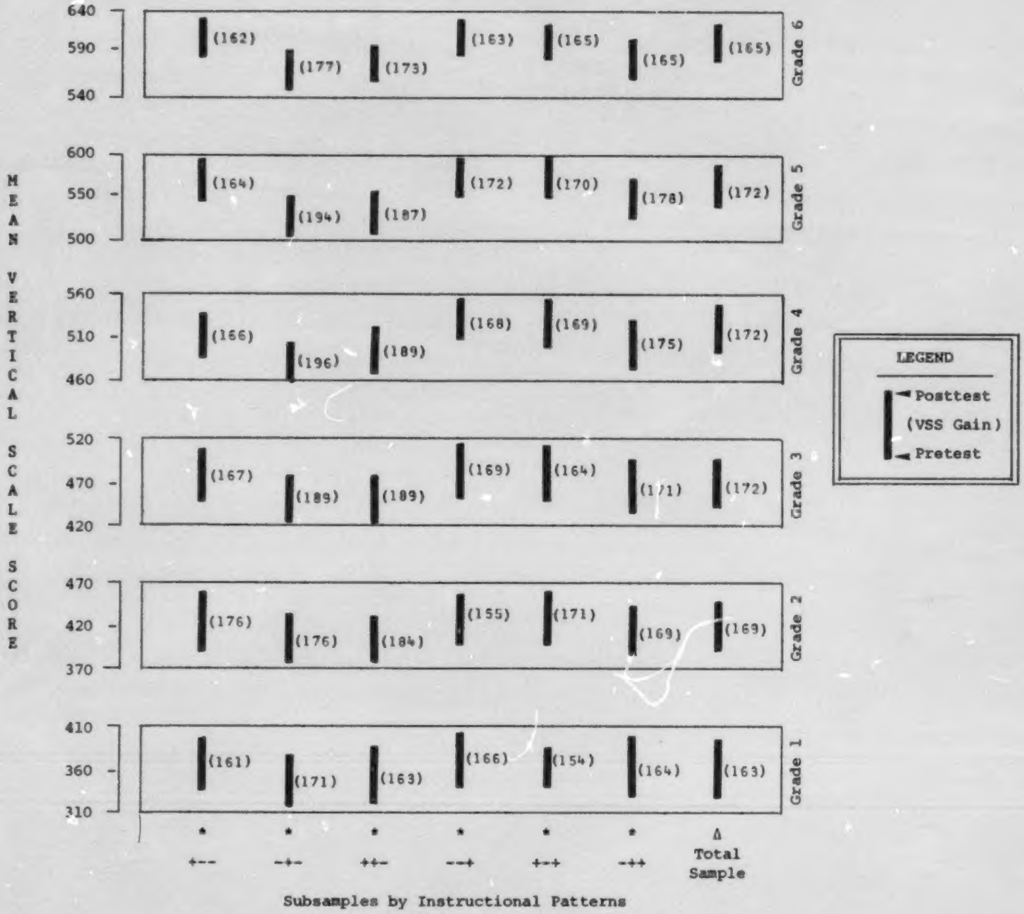
- Overriding the relationship between achievement growth and services received, different amounts and patterns of services are provided to students of different initial achievement status. Students who start with lower achievement receive greater amounts of services in patterns emphasizing special instruction while students who start higher receive lesser amounts, with less emphasis on special instruction.



(The three indexes of '+/-' used to designate each pattern show high/low proportions for regular instruction, special instruction, and tutor/independent work, respectively).

Figure 3-1

Fall-to-Spring Reading Achievement Growth by Grades and Instructional Patterns (Numbers in Parentheses Are Average Hours of Total Instruction Received in the 1976-77 School Year).



(The three indexes of '+/-' used to designate each pattern show high/low proportions for regular instruction, special instruction, and tutor/independent work, respectively).

Figure 3-2

Fall-to-Spring Math Achievement Growth by Grades and Instructional Patterns (Numbers in Parentheses Are Average Hours of Total Instruction Received in the 1976-77 School Year).

INSTRUCTIONAL SERVICES AND ACHIEVEMENT GROWTH—A REGRESSION APPROACH

An assumption underlying the correlational analysis is that, with the same educational experiences, individual differences in achievement increase proportionally to the increase in the population standard deviation. That is, individual differences remain constant over time if the differences are expressed in units of standard deviation at each time. For the purpose of later reference, let us define standard scores for achievement as the observed score (in VSS units) divided by the population standard deviation at the time of testing. Then if the standard scores for two individuals vary by x points at the pretest, they will again differ by x standard-score points at the posttest. The difference between their observed scores, however, may be greater at the posttest if the standard deviation becomes larger.

The assumption is, that in the absence of special intervention, individuals learn at different rates, such that the population standard deviation varies with time, but individuals maintain similar differences relative to it. A phenomenon consistent with this assumption is that high-achieving students learn at a greater pace than low-achieving students so that individual achievement growth curves spread out like an open fan. Hence, the term 'fan-spread' hypothesis is coined to explain the widening achievement gap between these two groups of students. The 'fan-spread' hypothesis is frequently accepted on an intuitive basis, although it is only partially supported by the observed increase of the standard deviation for achievement scores with grades.

Under this hypothesis, gains in standard scores are equal for all individuals sharing the same educational experiences. A simple model for examining effects of educational variables then is to assume a linear relationship between gains in standard scores and these variables. In the correlational approach, such a model was adopted to study the relation of achievement growth to instructional services received. Specifically, we postulated a regression model for gains in standard scores on total instructional time. It can be shown that the regression coefficient in this model is proportional to the differences between the correlation of pretest achievement with instructional time and that of posttest achievement with instructional time. The proportional factor is the ratio of the standard deviation of posttest scores to that of instructional time. Thus, the effects of instructional services on achievement can be assessed in terms of this correlational difference. A substantial increase (positive becoming more positive and negative becoming less negative) in the correlation between achievement and instructional time from pretest to posttest indicates a positive effect.

The correlational analysis accounts for the effects of differential learning rates in accordance with the fan-spread hypothesis. Consequently, it controls only for the pretest achievement differences and ignores potential direct effects of other student characteristics on learning. In this section, we refine our investigation of instructional effects by using both initial achievement and student characteristics to control for individual differences. Because there is no clear evidence for the stringent assumption of invariant individual differences in standard scores over time, the fan-spread hypothesis is not followed in the formulation of the new model. The relationships between posttest achievement and the control variables are simply assumed to be linear and additive. Furthermore, a linear relationship between the adjusted achievement growth and instructional services is assumed in order to assess the instructional effects. Thus, the current analysis employs a multiple regression model for posttest achievement on pretest achievement, student characteristics, and amount of instructional services.

One problem with the additive model is that it assumes a homogeneous relationship between instructional services and achievement growth for students with different initial achievement and background. In reality, there are often interaction effects between instruction and the control variables. That is, the same amount of instruction need not result in an equal amount of learning for the educationally disadvantaged and non-disadvantaged students. Lower-achieving students who often come from families with disadvantaged backgrounds are expected to require greater efforts to learn similar materials. Adding to this problem are the negative relationships of instructional services received with initial achievement and student background. If the adjustments for the preexisting differences in achievement and background are inadequate (mostly due to measurement errors and omissions of relevant variables), the practice of allocating more services to disadvantaged students could produce inadvertently a negative bias in the estimation of instructional effects. As a result, if instruction has positive but small effects, the model may fail to show them, or worse, may show negative effects.

One way to alleviate this problem is to introduce interaction terms into the model. However, this remedy can be inadequate because of the restriction to linear relations and because of the collinearity between the interaction and main terms. A better way to deal with the difficulty is by analyses of subsamples. Thus, the present analyses are focused on relatively homogeneous subsamples of students who are comparable with respect to initial achievement and background. Considering the special interests of this study, we included in the analysis only CE students (who, by virtue of their receiving CE services, were probably educationally deprived in some respects) and comparison non-CE students who were judged as needing CE by their teachers (and were found to achieve at similar levels as their CE peers, see Chapter 2). In this way, we hope to reduce the chance of finding negative instructional effects that are due to inappropriate analytical models.

Within this sample of students, the control variables are used primarily to remove as much systematic variation of the posttest achievement as possible so that the model is sensitive to the effects of instruction. For the same purpose, we further add four dummy-coded grouping variables to differentiate between students in terms of their CE statuses. By entering these grouping variables, between-group variation can also be removed in the estimation of disturbance variance.

Here, CE status can be employed to provide additional information on educational disadvantage that has not been contained in the background variables already used in the model, and educational experiences in areas other than instructional time (such as teacher's behavior in class, or school's environment). The effects of these unmeasured differences among groups are summarized by the regression coefficients for the dummy variables (sometimes known as intercepts). These coefficients are interpreted as group differences in achievement growth after adjusting for differences in initial achievement and background.

Analyses Method

In short, the present analysis assumes a multiple-linear-regression model for posttest achievement on pretest achievement, background characteristics and amount of instructional services. Four student characteristics that were found to be useful predictors of posttest achievement in previous analyses (see Chapter 2) were employed: white/minority status, participation in free or reduced-price meals, mother's educational attainment, and teacher's judgment of need for CE. Instructional services were measured by the time spent in the three instructional settings explained earlier in this chapter. The three composite measures of services were entered into the model, instead of the total instructional time, in order to examine their differential effects on learning.

The analysis sample was divided into five groups (hence four grouping variables were needed): Title I students, Other-Ce students in Title I schools, Other-CE students in Other-CE schools, needy Non-CE students in CE schools, and needy Non-CE students in Non-CE schools. For detailed descriptions of these groups, see Chapter 2. The students involved were regarded as educationally disadvantaged either because they were receiving CE or because they were judged as needing CE. The within-group regression surfaces were assumed to be parallel.

The analyses were aimed at determining if the instructional services were the primary mediating factors for learning. If this were the case, we could provide supplementary services to the students having special educational needs with the expectation that their performances would improve. Otherwise, we might find positive effects of CE, but could not understand how it works. In this situation, some might conclude recklessly that selection for CE alone produces miracles, disregarding what efforts are put into the program. Such a conclusion should be carefully avoided to prevent the danger of relegating CE to a perfunctory role in education.

The analyses were performed for reading and math separately. Except for three of the student characteristics (white/minority status, participation in meal programs, and mother's educational attainment), all other variables were defined specifically for reading and for math. In addition, similar analyses were also performed for the Practical Achievement Scale (PAS). In the analyses for the PAS, both sets of composite measures for reading and math instructional services were employed, and judged need for CE was redefined as having CE need in either reading or math. New categories of CE/comparison status were also defined for the analysis of practical achievement (see Table C1-5 of Appendix C1 for an explanation of these categories).

Results of the Analysis

The results are presented in two ways. First, the regression coefficients are examined to assess the direct effects of instructional services. If they are the primary underlying variables that mediate achievement growth, they will have positive and large coefficients. Additionally, the coefficients for the grouping variables (i.e., the intercepts) can be used to compare mean adjusted achievement growth among groups. A positive coefficient indicates that the corresponding group achieves a higher mean adjusted growth than the reference group (in our analyses, needy non-CE students in non-CE schools serve as the reference group). Significant coefficients for the grouping variables that represent CE students imply that CE has some independent effect on learning (probably due to differences in quality of services, educational practices, and other unmeasured student characteristics, overadjustment of preexisting differences, or perhaps even Hawthorne effects).

Second, we are interested in studying the joint effects of different sets of variables (background, amounts of services, and CE/comparison status). In the absence of an explicit causal model to describe the interrelationships among the independent variables, the joint effect may be described by means of the commonality analysis. The commonality analysis partitions the variance of the posttest scores into various components: unique to each set of variables, and shared by two or three sets of variables. For details of the rationale and computational procedures for the analysis, the reader may refer to Mood (1971), Newton and Spurrel (1967), and Wisler (1968).

Our objective is to assess the unique contribution of instructional services to the explanation of posttest variation. If the instructional services can independently explain the differences in achievement growth, the unique component for the set of service variables will be substantial. On the other hand, if the effects of different sets of variables are highly correlated, the common components will dominate. In this case, it will be difficult to determine the role of instructional services in effecting achievement growth.

The Direct Effects of Instruction on Achievement. Table 3-2 presents the zero-order correlations (r) and the standardized regression coefficients (β) for the analyses of reading (top half) and math (bottom half) achievement. Similar data for the analyses of the PAS are provided in Table 3-3. Among the three service variables, only the amount of regular instruction demonstrates a positive and significant (at the .01 level) relationship with achievement growth. Positive effects of regular instruction are shown in grades 1 and 2 for reading and in grades 2, 4, 5, and 6 for math. The amount of special instruction shows a significantly positive effect only in grade 4 for math.

Turning to the coefficients for the grouping variables, it can be seen that, among CE students, Title I students benefit most from CE services. They frequently achieved an average adjusted growth exceeding that for the comparison Non-CE schools (in the lower two grades for reading and in all grades but grade 4 for math). While these latter findings are consistent with the positive effects of CE found in Chapter 2, the lack of evidence for substantial effects of instructional services leaves us little comfort. Amount of instruction, particularly of the special instruction which characterizes the services received by CE students, is not strongly related to achievement growth.

The results for the PAS are mostly insignificant except in grade 4 (see Table 3-3). As remarked in Chapter 2, the insensitivity of the single-level test to the progress in practical achievement at later grades may explain our inability to find sizable effects.

Table 3-2

Predictor-Criterion Correlations and Standardized Regression Coefficients for the Regression of Reading/Math Posttest Score on Pretest Score, Student Background Characteristics, Hours of Instructional Services Received, and CE/Comparison Categories*

Predictor Variables		Correlation with Posttest Score (r) and Standardized Regression Coefficients (β)											
		Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
		r	β	r	β	r	β	r	β	r	β	r	β
Reading Achievement	N =	4,298		4,526		4,306		3,898		3,807		4,109	
Pretest VSS Score		.56	.49**	.68	.59**	.72	.65**	.74	.67**	.78	.74**	.80	.75**
Student Background Variables													
White/Minority Status		.04	-.07**	.22	.07**	.72	.04**	.22	.04**	.21	.03**	.29	.05**
Free-Meals Participation		-.12	-.02	-.24	-.08**	-.25	-.04**	-.26	-.03**	-.26	-.07**	-.28	-.04**
Mother's Educational Attainment		.25	.10**	.23	.05**	.27	.08**	.23	.06**	.21	.03**	.25	.05**
Judged Need for Reading CE		-.32	-.14**	-.33	-.09**	-.34	-.07**	-.32	-.08**	-.26	-.04**	-.26	-.05**
Instructional Services Received													
Regular Instruction		.12	.09**	.16	.08**	.08	.00	.10	.02	.03	.03	.07	.04**
Special Instruction		-.07	.01	-.15	-.02	-.20	-.03**	-.19	-.02	-.18	-.01	-.23	-.01
Tutor/Independent		.04	.01	.06	-.00	.08	.00	.06	.03	.11	.02	-.03	.02
CE/Comparison Categories													
Title I/Title I		.06	.11**	-.07	.06**	-.08	.05	-.10	.00	-.10	.03	-.13	.02
Other-CE/Title I		.10	.04	.16	.05	.12	.03	.08	-.01	.07	.02	.15	.02
Other-CE/Other-CE		.03	.02	.04	.05**	.04	.03	.05	-.01	.04	.04	-.06	-.03
Needy Non-CE/CE		-.10	.06**	-.04	.04	.02	.05**	.03	.01	.06	.04	.08	.03
Math Achievement	N =	3,203		3,217		3,425		3,255		3,342		3,598	
Pretest VSS Score		.57	.50**	.65	.58**	.63	.58**	.68	.66**	.71	.68**	.72	.69**
Student Background Variables													
White/Minority Status		.02	-.03	.12	.02	.17	.06**	.15	.00	.11	.03	.11	.02
Free-Meals Participation		-.08	-.03	-.13	-.03	-.17	-.07**	-.20	-.06**	-.15	-.04**	-.13	-.02
Mother's Educational Attainment		.18	.04**	.18	.05**	.14	.05**	.17	.03	.13	.01	.16	.03
Judged Need for Math CE		-.33	-.10**	-.34	-.13**	-.28	-.11**	-.27	-.03	-.25	-.04**	-.26	-.07**
Instructional Services Received													
Regular Instruction		.03	.03	.05	.07**	.04	.04	.06	.06**	.12	.08**	.09	.06**
Special Instruction		-.03	-.00	-.08	-.02	-.08	-.05**	-.06	.07**	-.14	-.01	-.09	.02
Tutor/Independent		-.01	.02	.06	.00	.02	.01	.09	.06**	-.01	.03	.01	.04**
CE/Comparison Categories													
Title I/Title I		.09	.12**	-.01	.06**	.03	.10**	-.01	.02	-.00	.06**	.01	.05**
Other-CE/Title I		.17	.07**	.17	.04	.10	.00	.14	.02	.13	.03	.13	.03
Other-CE/Other-CE		.10	.06**	.08	.03	.04	-.01	-.00	-.07**	.02	.03	-.03	-.01
Needy Non-CE/CE		-.16	.04	-.07	.05**	-.08	.01	-.05	.02	-.02	.04	-.01	.03

*The student background characteristics employed in the Analysis are coded as follows: White/Minority Status (1 = Caucasian-White; 0 = Minority), Free-Meals Participation (1 = Participant of free or reduced-price meals; 0 = Non-participant), Mother's Educational Attainment (1 = High school graduation or more; 0 = less than high school), and Judged Need for CE (1 = Need CE; 0 = No need). Instructional Services Received and CE/Comparison categories are subject-specific variables (see the text for description of these variables).

**Indicates that the regression coefficient is significantly different from zero at the .01 level.

Table 3-3

Predictor-Criterion Correlations and Standardized Regression Coefficients for the Multiple Regression Analysis of the Practical Achievement Scores*

Predictor Variables for the Posttest Score	Correlation with Posttest Score (r) and Standardized Regression Coefficients (β)					
	Grade 4		Grade 5		Grade 6	
	r	β	r	β	r	β
N =	4,304		4,244		4,584	
Pretest Practical Achievement Score	.62	.56**	.67	.62**	.68	.63**
Student Background Characteristics						
White/Minority Status	.21	.07**	.19	.05**	.22	.06**
Free-Meals Participation	-.21	-.04**	-.20	-.05**	-.21	-.02
Mother's Educational Attainment	.19	.05**	.19	.03**	.22	.08**
Judged Need for Reading and/or Math CE	-.25	-.11**	-.23	-.06**	-.18	-.05**
Instructional Services Received in Reading						
Regular Instruction	.07	.00	.03	.02	.08	.03
Special Instruction	-.15	-.04	-.15	-.02	-.22	-.03
Tutor/Independent	.03	.02	.08	.03	.04	.03
Instructional Services Received in Math						
Regular Instruction	.07	.11**	.04	.02	.05	.04
Special Instruction	-.09	.06**	-.13	-.01	-.13	-.01
Tutor/Independent	.07	.06**	.04	.02	.05	.03
CE/Comparison Categories						
Title I/Title I	-.08	.01	-.09	.04	-.11	.04
Other-CE/Title I	.06	-.00	.07	.03	.07	.02
Other-CE/Other-CE	.03	-.02	.02	.02	-.02	.01
Needy Non-CE/CE	.03	.03	.05	.07**	.09	.04

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*The Practical Achievement Scale was administered to grades 4, 5, and 6 only. For descriptions of the background variables, see Table 3-2. The CE/Comparison Categories were defined on the basis of the student's joint status in reading and math CE. Table C1-5 of Appendix C1 explains how these categories are obtained. The service variables are described in the text (in the section entitled 'The Measurement of Instructional Services', page 3-4).

Returning to Table 3-2, it can be seen that the pretest score is obviously the most powerful predictor of achievement, followed by judged need for CE. Race/ethnicity (white/minority status) and economic status (participation in meals program) are not as important in predicting achievement in math as in reading or in the PAS.

Interpretation of Findings. The absences of positive effects for special instruction led to the suspicion that because special teaching staff often were hired with CE funds and their jobs tended to be unstable, they might be less qualified than the regular staff. However, there was little evidence in previous studies to support this contention. For instance, the NIE (National Institute of Education) survey of Title I districts revealed that districts selected Title I teachers usually on the basis of academic training and experiences with educationally disadvantaged children, but rarely on the basis of seniority (NIE, 1978). The NIE study also found that CE teachers tended to have higher levels of educational attainment and more recent training experiences than homeroom teachers. Despite these findings, the doubts remained. In order to clear suspicion, we compared the qualifications between regular classroom and special teachers.

In the Teacher Questionnaire, Parts B and C, the teachers were asked to indicate what type of reading/math teachers they were: (1) regular classroom teacher; (2) special teacher providing instruction to students during the regular class period; or (3) special teacher providing instruction in addition to that received by students during the regular class period. The teacher's self-classification can be partially verified by data from the Student Participation and Attendance Record and the Student-Teacher Linkage Roster. A teacher's response was accepted only if he/she provided some instruction of the specific type to at least one student. For instance, a special teacher should be linked to at least one student whose record showed receipt of non-zero hours of instruction from special teachers (regardless of the size of instructional group). Teachers whose responses could not be confirmed by their students' attendance records were excluded from the analysis.

The analyses were performed for each grade and for reading and math separately. All teachers who provided some reading (math) instruction to at least one student in a given grade were included in the respective analysis for that grade. By grades, about 5 to 9 percent of reading teachers and about 12 to 15 percent of math teachers were deleted from the particular analysis because their responses were inconsistent with their students' records of instructional services received.

Five variables taken from the Teacher Questionnaire, Part A, were used to describe the teachers' qualifications: (1) number of years teaching in any school (total teaching experience); (2) number of years teaching in current school; (3) highest earned college degree; (4) number of college courses taken in teaching reading/math; and (5) number of hours of inservice training in reading/math during the previous three years. These data are summarized in Table C1-6 of Appendix C1.

The analyses show that special teachers generally do not differ from regular classroom teachers in their total teaching experience, but tend to have taught fewer years in the current school. The teachers on the average have about 11 years of teaching experience, a result corroborating the data reported by the National Education Association (1977). The three types of math teachers are not different with respect to their academic degrees earned. By contrast, special reading teachers tend to have attained higher degrees than regular teachers.

Consistent differences between special and regular teachers are obtained in terms of their training. Special teachers clearly have received more inservice training than classroom teachers. This finding is expected in light of the policy that districts may use CE funds to provide inservice training to teachers, especially to those serving CE students. In addition, special teachers also have taken more college courses in teaching their specific subjects.

Our analysis thus far showed that the overall qualifications of special teachers were in fact higher than that of the regular teachers. The failure to uncover positive effects of special instruction cannot be blamed on the low qualifications of the teachers. We suspect that the present study may involve too short a time interval to demonstrate strong effects of instruction, that the effects of instruction require a longer period to manifest themselves. This suspicion awaits confirmation in a subsequent report (Report 15) which analyzes the three-year data. Additionally, the inverse relationship between service allocation and achievement level also tends to mask whatever positive effects the instructional services might have on the achievement growth of the disadvantaged students.

Finally, it may be noted that the positive relationship between the total instructional time and reading achievement growth in grades 4 and 5, as evidenced in the correlational analyses, is not shown in the multiple regression analyses. The discrepancy between the findings may be explained by the different samples involved in the analyses. To some extent, the significant result in the earlier analyses for the entire sample may be explained by the large sample size. However, it is quite possible that the positive relationship may not exist for the educationally deprived students. This latter conjecture is compatible with the observation that in spite of more instruction received by CE students in these two grades, they have not shown significantly greater progress than that for the comparison Non-CE students who received less instruction (see Chapter 2). What is needed to improve the achievement of these students may be effective teaching rather than time.

The Joint Effects of Instruction and Student Background. In order to provide some information on the joint effects of the background variables and instructional services, the variance of posttest scores is partitioned into unique and shared components in Table 3-4. The unique contributions by the set of service variables (set B), and the set of CE/comparison grouping variables (set C), are very small. Most of the contributions by these two sets of variables are made jointly with the set of pretest and background variables (set A), as indicated by the larger common components for sets A and B, and for sets A and C. Clearly, pretest achievement and background characteristics are the dominating factors for explaining the posttest-score variation. In fact, pretest score alone accounts for most of the explained posttest variance (ranging from 31 to 64 percent for reading, 32 to 52 percent for math, and 38 to 46 for PAS).

SUMMARY AND CONCLUSIONS

The multiple regression approach gives the following results:

- There is no striking evidence that amount of instruction is the primary factor that mediates achievement growth. Amount of Regular instruction is the only kind of service found to be positively related to growth.

- Consistent with the results of Chapter 2, CE programs often show positive impacts on the achievement growth of their participants, Title I students in particular. The positive but small impact is observed more frequently in math than in reading. However, little is known about the underlying mechanism that explains these small effects.

To conclude our discussion, we would like to emphasize that the relatively slight explanatory power we find for the amount of the three kinds of instruction should not cause despair in the educational community. The following thoughts may make the point:

- Increased amount of services may be critical for raising the achievement level of low-achieving students, even if we have not yet been able to show a clear and strong relationship between the amount of instruction and achievement growth. It is possible that increased services do help accelerate the growth rate of these students, but the amount is still not enough to overcome their severe educational disadvantage. This could be the situation especially for reading in the upper grades, where extensive effort could be required in order to compensate for the accumulated deficiencies in the reading skills of CE students. The receptiveness of such students to increased or improved services and the ability or desire of society to provide them as speculative investments are, of course, other important considerations.

- It is reasonable to think that improvement in the quality of services, not just the amount, will result in greater effects on achievement growth. The mission for us, then, is to continue our efforts in identifying and developing better kinds of instructional services.

Table 3-4

Partition of the Proportion of the Posttest Score Variance Accounted for by Pretest Score and Student Background Characteristics, Instructional Services Received, and CE/Comparison Categories for the Three Groups of CE Students, and Two Groups of Non-CE Students Judged To Be in Need of CE

Grade	Proportion of Posttest Score Variance Accounted for by the Disjoint Components of Variance: A = Pretest and Student Background Characteristics, B = Yearly Hours of Instructional Services Received, and C = CE/Comparison Categories*							Squared Multiple Correlation
	Unique to A	Unique to B	Unique to C	Shared by A and B But Not C	Shared by A and C But Not B	Shared by B and C But Not A	Shared by A, B and C	
Reading Achievement								
1	.3061	.0073	.0046	.0170	.0285	-.0002	-.0085	.3548
2	.4247	.0070	.0012	.0313	.0322	-.0005	-.0014	.4945
3	.4770	.0010	.0009	.0431	.0223	-.0001	-.0021	.5421
4	.5029	.0014	.0002	.0381	.0149	.0003	.0005	.5583
5	.5674	.0010	.0008	.0364	.0125	.0001	.0050	.6232
6	.5727	.0016	.0017	.0435	.0266	.0000	.0114	.6575
Math Achievement								
1	.2740	.0013	.0067	.0087	.0689	-.0003	-.0084	.3509
2	.3785	.0058	.0018	.0140	.0561	-.0007	-.0077	.4478
3	.4011	.0048	.0080	.0114	.0192	-.0025	-.0065	.4355
4	.4472	.0059	.0057	.0118	.0147	.0004	-.0004	.4853
5	.4568	.0046	.0019	.0271	.0269	-.0001	-.0067	.5105
6	.4914	.0020	.0021	.0192	.0267	.0000	-.0071	.5343
Practical Achievement								
4	.3798	.0107	0015	.0217	.0053	.0006	.0014	.4210
5	.4191	.0029	.0015	.0257	.0067	.0008	.0040	.4607
6	.4197	.0058	.0008	.0401	.0104	.0000	.0087	.4855

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*Variables in Set A are Pretest Score and the four student characteristics. Set B consists of the composite measures of instructional services in reading and/or math. Set B contains the four dummy-coded grouping variables for CE/Comparison Status. See Tables 3-2 and 3-3 for listings of these variables.

INSTRUCTIONAL SERVICES AND ACHIEVEMENT GROWTH—A STRUCTURAL-RELATION MODEL APPROACH

In Chapter 2, where we evaluated the overall effects of CE, and in the preceding sections of this chapter where we relied on regression approaches to examine the relationship between instructional services and achievement growth, a single test score was employed as the measure of achievement at a given time (pretest and posttest). The CTBS vertical-scale score obtained with the 'SDC recommended' test level (see Chapter 1) was used in those analyses. One of the major concerns in such analyses is the measurement errors of test scores, particularly when they are used as covariates or regressor variables.

To deal with the problem of measurement errors explicitly, one needs multiple observations on the same variable. In the first year of data collection for this study, two adjacent levels of CTBS are assumed to measure the same thing—achievement, and thus enable us to equate the tests on the basis of the double-testing procedure. On this same basis, it is reasonable to consider the two test scores as two indicators of a same construct (achievement at the time of test). We may then formulate a measurement model assuming the two levels of tests are congeneric. A set of tests are congeneric if they measure the same thing (i.e., their 'true' scores are linearly related, Jöreskog, 1970; 1971). With such a model we may estimate test reliabilities and examine relationships between achievement and other variables after removing the measurement errors from the test scores (the error-free scores are often referred to as 'true' scores).

The use of both test scores from the two levels in the analysis also addresses the concern that different test levels employed in different schools may introduce spurious test effects in the assessment of student achievement. The practice has the advantage of basing the construct of achievement on a wider range of test content and thus of being more appropriate for a broader spectrum of curriculum. Therefore, the analyses in this section will utilize the double test scores at each test administration to measure achievement.

Related to the measurement issue is the concept of a background factor that constitutes an important element in achievement models. This factor is frequently referred to as socioeconomic status or socioeconomic index. In our earlier analyses, a number of student-background variables available in the Student Background Checklist (SBC) were entered into the same regression model concurrently in order to study their relations to achievement growth. With such an approach, there is no simple index for the joint relationship of these variables with achievement. In light of a general acceptance of the concept of a socioeconomic index, it is desirable to postulate a common factor (latent variable) to represent these background variables. Then we can examine the influence of socio-background (social origin) on achievement in terms of the hypothesized common factor (construct). To this end, a measurement model that defines a socio-cultural advantage factor (SCAF) on the basis of the background variables is incorporated into the present analyses.

Explicitly, a dichotomous variable for Race/Ethnicity (non-Hispanic whites vs. minorities) serves as an indicator that reflects one's cultural origin. A second dichotomous variable for participation in free or reduced-price meals serves as an indicator that represents the economic aspect of the common factor. This indicator is a proxy of family income, family size, and type of family (farm or nonfarm) because it is determined on the basis of these criteria. A third observed indicator is mother's educational attainment which is believed to affect the educational climate and social environment in the home. These three aspects of the factor are related to the child's initial achievement and continuing educational growth in some joint manner.

Aside from measurement problems, the earlier regression analyses also suffer from the limitation of revealing only the direct relations between the dependent and independent variables. There is little information on the role of the interrelationship among the independent variables in the determination of the relationship between each of them and the dependent variables. Traditionally, the technique of path analysis (Wright, 1934, 1960; Tukey, 1954) is employed to sort out the complex interrelations among the variables. This approach employs a form of simultaneous multiple regression analysis, and is referred to generally as causal modeling or linear structural modeling. (Path analysis only deals with manifest variables and does not solve the problem of measurement errors.)

However, recent methodological advances by Jöreskog and his colleagues have made possible an integrated approach to the problem of measurement errors and the modeling of linear structural relations by embedding ordinary path analysis in a factor analytic framework (Jöreskog, 1969, 1970, 1973, 1974, 1978; Jöreskog and Goldberger, 1975; Jöreskog and Sörbom, 1976, 1977). Thus, structural relations among 'error-free' variables (latent constructs) are represented by simultaneous linear equations; and measurement errors of the indicators (observed variables) are estimated with factor analytic models. Bentler (1980) provides a thorough review of the development and applications of this method. A computer program 'LISREL IV' (Jöreskog and Sörbom, 1978) can be employed to find solutions for a general family of linear structural relation (LISREL) and measurement models. The program has greatly facilitated the application of Jöreskog's model to real data.

For our present purpose, the LISREL IV program was applied to obtain solutions (estimates of parameters in the model) for achievement models that simultaneously address the issues of measurement errors and examine the interrelations among achievement, student background, and receipt of instructional services. Two models were formulated in order to help us understand the role of instructional services in effecting achievement growth.

General Description of the Analytical Models

The first model is a path-analytic model with both latent and observed variables for a single population. The model is applied to the data from the entire first-year sample with a specific interest in estimating the direct effects of amount and kind of instruction received on achievement growth. However, it may not be appropriate for examining the effects of instructional services on the achievement of CE students because of the problem of selection bias. With a special interest in the achievement growth of disadvantaged students, we employ a second model to study a restricted sample that includes only CE students, and non-CE students who are judged as needing CE. The needy non-CE students serve as comparison groups in the analysis because of their similarity to CE students with respect to achievement status and background.

The policy of compensatory education generally requires schools to provide additional services to students with special educational needs. These students are low achievers and often come from low-income families, so there are large background differences between them and their non-disadvantaged peers. In light of such differences, CE students are expected to learn at a slower pace in the absence of special assistance. This kind of selection bias (the differential growth rates, in particular) cannot be adequately adjusted with the linear, additive model for the total sample. The best way to deal with the problem is to incorporate an explicit model for the selection process into the analysis so as to account for the bias.

Unlike the econometric studies, a satisfactory and technically tractable model for the selection process in CE has not been developed because of its great complexity. (A brief discussion of the current selection policy will be provided later.) Under this circumstance, an effective strategy to cope with the problem is to control for the large preexisting differences by employing comparison groups that have characteristics similar to the CE groups. Then a similar model can be applied to analyze the data from the comparison and the target groups simultaneously. We thereby aim at reducing potential selection biases so that the effects of instructional services and the role of CE can be examined properly.

The second model is an ANCOVA (analysis of covariance) model with latent variables as proposed by Sörbom (1978). It allows examination of within-group relationships between variables and comparisons of factor means (means for latent variables) among groups. The focus of this model is to compare the differences in posttest achievement between CE and comparable non-CE students after adjusting for their differences in pretest achievement, socio-background, and receipt of instructional services. If differences in adjusted posttest achievement still exist, we suspect that other variables, in addition to preexisting differences in initial achievement and background, and differences in amount of services received, are also responsible for explaining achievement growth. This information combined with the estimates of the direct effects of instructional services on achievement will provide insights into further search for the underlying factors in the transmission of achievement status from one time to another. We have a special interest in the effects of instructional services because they are the variables most directly regulated in CE policy as implied by the 'Supplementary Service' clause in the Title I guidelines. Other variables such as classroom practices are less subject to explicit regulation.

Additionally, the second model allows us to compare means for the pretest achievement factor, for the socio-cultural advantage factor, and for amount of services received between CE and non-CE students. Such comparisons can be used to describe the effectiveness of CE targeting and its relation to allocation of services.

Detailed descriptions of the two models will be given later when their results are discussed. However, it is helpful to note at this point that all variables involved in the current analyses have been explained earlier in the beginning of this chapter. The only exception is that scores from the two adjacent test levels, instead of only those from the recommended level, are included in the analyses. This addition to the data is required in order to examine the measurement errors of test scores.

Another comment on the data is that we have treated the three composite variables of services as 'error-free'. It should be noted that they are inappropriate to serve as multiple indicators of a general construct underlying amount of services received, because they often represent alternative forms of services rather than duplicative measures of services. This characteristic is evidenced by the negative correlations among them, particularly between the amounts of regular and special instruction.

It is possible to argue for using the four sets of service data collected in four bimonthly intervals during the year as multiple observations so that teachers' reporting errors may be removed by means of the measurement model. This strategy was not adopted for several reasons. For example, the patterns of instructional services need not be stable over time—instructional arrangement may be changed according to progress in the curriculum and student needs, or there may be a rotation of the arrangements among students. Attendance which directly affects actual receipt of services may also vary with season. Another consideration is that excessive computer time may be required for the LISREL program to converge to a solution when the model involves large numbers of parameters. For practicality, we think that the accumulated amount of services received during the period is reasonably accurate and relevant to total learning in that interval. We therefore prefer to enter each of the three service composites directly into the structural relation model without hypothesizing a latent variable for them.

Technical Considerations of the Analytic Approach

Before we turn to a detailed discussion of the analyses, it is helpful to address some of the common technical problems in fitting the models. The first concern in the application of the LISREL IV program is the robustness of the parameter estimates with respect to departures from multivariate normal distributions. Specifically, many of the variables in the model are discrete. Although Jöreskog (1978) has called for efforts to investigate models involving discrete variables, little progress has been made in this area. The distributional problem can be particularly acute in the hypothesized socio-cultural advantage factor based on three dichotomous variables.

For an empirical examination of the robustness characteristic in models where latent variables are defined in terms of discrete variables, see Olsson (1979). In general, one expects some lack of fit for the model to result from the distributional violations. In connection with the same issue, it is also inappropriate to regard the measurement model as one that deals with observation errors. In this case, however, our intention is to extract a common factor and then to examine the relations of these variables with other variables in terms of this factor. For this reason, we specifically use the term 'unique factor' in place of the term 'measurement error' in the usual LISREL formulations.

Another important issue is the problem of specification error. In any modeling process, whether it deals with fallible or latent variables, omission of variables that interrelate with some of the variables in the system can introduce biases to the estimates of the parameters in the model. As we frequently are forced to leave out important variables due to lack of observed indicators in the data base, we have to be very cautious in drawing conclusions from the results of our models. For instance, the ability factor (some may prefer to use the terms 'aptitude' or 'intelligence'), which partially determines a student's achievement status and thereby relates to selection for CE services, pretest achievement, and posttest achievement, is not measured in the study and not included in our model.

Perhaps the most difficult issue is the philosophy of model fitting. Our stance is that the building of a model should be strictly guided by theory and that the model fitting serves only as a confirmatory process. Once the structural relations are specified in the model to reflect the theory, one may proceed to obtain a solution for the model (i.e., to obtain estimates of the parameters) in order to examine the agreement between the theory and the data.

A dilemma in our present application is that the asymptotic X^2 measure of goodness of fit is extremely sensitive when the data involve a large sample size (N). Slight departure of the model from the data can lead to its rejection because the X^2 statistic is directly proportional to N. In this case, Jöreskog (1969, 1978) suggests that the statistical problem be viewed as one of comparing the fit of a sequence of hierarchical models to decide on the selection of the models, instead of one of rejection or confirmation of a given model. He also advises the model selection should not be decided purely on a statistical basis. We strongly agree with his emphasis on the importance of the investigator's interpretations of the data based on substantive, theoretical, and conceptual considerations. Accordingly, we choose to focus our attention on the meaning of the resulting parameter estimates.

Occasionally, hypothesis testings are made in order to gauge the statistical significance of a coefficient or of differences among groups. In such cases, we adopt a stringent criterion for the rejection of the null hypothesis. For the most part, however, we will deemphasize the importance of the overall fit of the model and concentrate our discussion on the implications and usefulness of the model for explaining achievement.

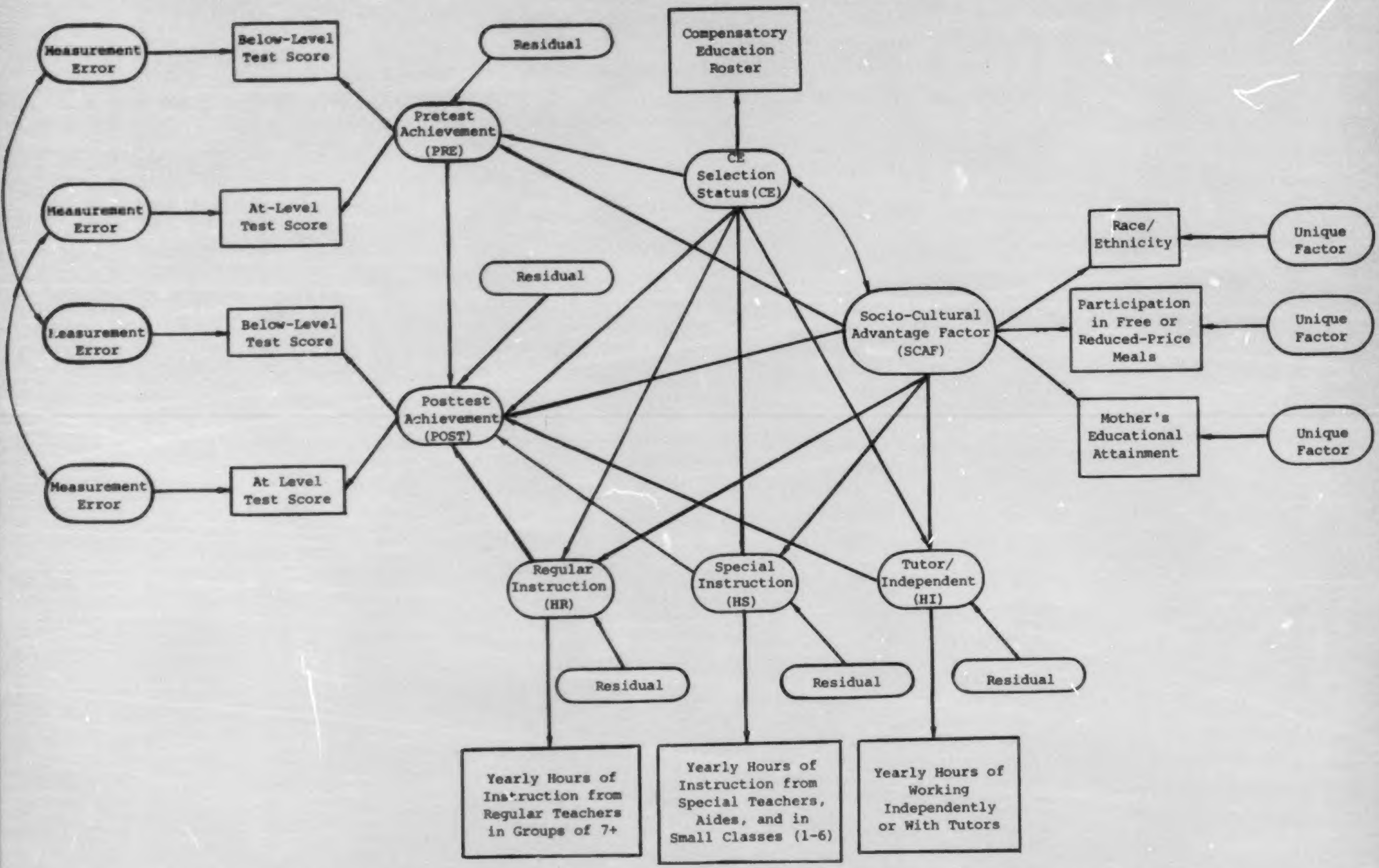
A General Path Model for Reading and Math Achievement

One of the major purposes of CE is to provide supplementary services to its participants in the belief that the additional assistance will have beneficial effects of accelerating their achievement growth. Accordingly, we are especially interested in examining the role of CE in raising the achievement level of its participants in terms of its effects on service allocation and the effects of services on achievement growth. To this end, we postulated a path model to describe the interrelationship among student CE status, receipt of instructional services, and socio-background, and the roles of these factors in the transmission of achievement status from the beginning to the closing of a school year.

The model, as depicted in Figure 3-3, is applied to data for each of the six grades, and for reading and math, separately. We employ the data from the entire sample to appraise the usefulness of this model in furthering our understanding of the achievement process. For the benefit of technical readers, mathematical formulations of this model are provided in Appendix C2.

Following a convention of structural-relation modeling, we use rectangles to denote observed variables, while ellipses are used to indicate latent variables. When there is only a single indicator for a latent variable, no error term can be estimated. In this case, the latent variable is technically indistinguishable from its observed indicator. The latent variables are connected with arrows to show their structural relations. A single-headed arrow indicates a specific direction of the relation, while a double-headed arrow indicates a non-directional relation.

A directional relation can be interpreted as a causal chain in the theory: the variable at the origin exerts some direct influence on the variable to which the arrow points. A non-directional relation is stipulated in two situations: when the variables indeed have mutual influence on each other, or when both variables are related to some other common variables which have been left out in the system because of lack of data. In addition, directional arrows are drawn from the latent constructs


Measurement Error
Below-Level Test Score
Residual
Compensatory Education Roster
Pretest Achievement (PRE)
CE Selection Status (CE)
Measurement Error
At-Level Test Score
Race/ Ethnicity
Unique Factor
Residual
Socio-Cultural Advantage Factor (SCAF)
Participation in Free or Reduced-Price Meals
Unique Factor
Measurement Error
Below-Level Test Score
Posttest Achievement (POST)
Mother's Educational Attainment
Unique Factor
Measurement Error
At Level Test Score
Regular Instruction (HR)
Special Instruction (HS)
Tutor/ Independent (HI)
Residual
Residual
Residual
Yearly Hours of Instruction from Regular Teachers in Groups of 7+
Yearly Hours of Instruction from Special Teachers, Aides, and in Small Classes (1-6)
Yearly Hours of Working Independently or With Tutors

(The model applies to data for grades 3 through 6. For grades 1 and 2, the two correlations between measurement errors for test scores are replaced with a single correlation between the measurement errors for at-level pretest and below-level posttest scores)

Figure 3-3
Description of the Path Model for Reading and Math Achievement

and 'error' variables (common and unique factors, respectively) to the observed indicators to represent the measurement structure of the constructs (i.e., the observed indicators are linear combinations of the common and unique factors).

Description of the Path Model. The essential components of the model and the hypothesized structural-relations among them are explained below:

- As illustrated in Figure 3-3, a dichotomous variable based on student's CE record is used to show whether a student was selected for any CE services in the 1976-77 school year. Selection for CE services is assumed to have some direct effects on receipt of instructional services in three different settings (regular, special, and tutor/independent). In turn, these three service variables are assumed to have direct effects on posttest achievement.

- Because one's socio-background frequently affects the type of education one receives (Blau and Duncan, 1967; Duncan, 1968; and Coleman, 1975), it is reasonable to stipulate a socio-cultural advantage factor that influences receipt of services. The socio-cultural advantage factor (SCAF) is hypothesized on the basis of three aspects of home background: cultural (Race/Ethnicity), economic (with participation in free or reduced-price meals as a proxy), and educational (with mother's education as a proxy). This factor is likely to exert influence on receipt of services through its relationship with the type of school one attends (and thus the resources available). Because the school factor is absent in our simplified model, the SCAF is assumed to have direct effects on instructional services received. Hence, there are some indirect effects of SCAF on posttest achievement as a consequence of its influence on receipt of services.

- The SCAF is considered as a determinant of pretest achievement, because all three aspects underlying this factor are related to home environment for previous outside-school learning and prior experience in schooling. The earlier (pretest) achievement is expected to have a major role in determining the later (posttest) achievement. Therefore, a direct path from pretest achievement to posttest achievement is specified in the model. Thus, the model also examines the indirect effects of the SCAF on posttest achievement through its association with pretest achievement.

- Besides the indirect effects of SCAF on posttest achievement in terms of its relations with other variables in the model, it is assumed to have some direct effects on posttest achievement. The addition of a direct path from SCAF to posttest achievement stems from the consideration that it reflects the current home environment for continuing outside-school learning. Moreover, it may be related to aspects of schooling (e.g., peer group characteristics and qualification of teachers in the school) other than amount and kind of instruction received.

- Based on a similar rationale, direct effects of CE status on posttest achievement are hypothesized to account for other CE effects that are not mediated by receipt of services. By doing so, we in fact regard the dichotomous CE-status variable not only as a factor that determines the delivery of supplementary services to the participants, but also as a proxy of all unmeasured variables (Heckman, 1978) that represent the differences in characteristics of educational process experienced by CE and non-CE students during the year.

- As explained earlier, scores on two adjacent levels of CTBS tests serve as double indicators for achievement at a given time (pretest and posttest). When two scores are obtained with a same test level, their error factors may be correlated (Sörbom, 1975). Therefore, the model indicates a correlation between the errors for at-level pretest and below-level posttest scores for grades 1 and 2. For grades 3 through 6, correlated errors are assumed between the two at-level scores and between the two below-level scores.

The above discussion leaves two components in the model that still require explanation. First, the relation between CE-status and SCAF is specified to be non-directional. Second, there is a direct link between pretest achievement and CE status. In order to justify these specifications, we need to have some knowledge of how CE programs are implemented. We now provide some explanation for our decision regarding these two paths:

- The common practice of CE programs, and Title I in particular, is to allocate funds to districts and schools primarily on the basis of an economic criterion (e.g., percentage of students from low-income families). Within the schools, students are, however, selected for CE services primarily on an educational basis (e.g., low-achieving). Thus, the relationship between CE status and student background is not a simple unidirectional one. Rather, the background factor can affect the kind of school a student attends. If a child enrolls in a school that provides CE services, he/she may then be selected to receive CE on the basis of achievement status (or educational need). In the light of this indirect connection between background and CE status, we choose to examine only their intercorrelation without indicating the direction of the relation.

- Regarding the CE selection criteria within schools, our informal survey indicated that schools frequently based the selection on achievement scores in the previous year (particularly in spring) and teacher recommendations. In the first study year, the pretest results were not available to the schools in time to be used as a reference for that year's selection. Instead, participation in CE suggests a low-achieving status in the previous year. The close tie between CE status and previous achievement, which is a determinant of pretest achievement, makes it reasonable for us to argue for a direct role of CE in predicting pretest achievement.

- On this basis, we add a direct path from CE status to pretest achievement in order to account for their relationship. In this vein, CE status is viewed as a proxy both of achievement prior to the pretest and of other unmeasured background characteristics that can affect learning. The advantage of having this explicit path in the model is that it allows us to separate the direct effects of CE on posttest achievement from its indirect effects. CE status has a direct effect on posttest achievement when it is regarded as representing special educational experiences unrelated to instructional time. It has an indirect effect on posttest achievement by virtue of its role in determining pretest achievement.

It is important to remark that a reversed direction for the path between CE status and pretest achievement apparently is more acceptable to many because they believe that achievement status causes selection for CE but not vice versa. The problem with this idea is that it misplaces the temporal order of events: in actuality, selection for CE services precedes the pretest, especially for the first year of the study. Besides, the assumption that pretest achievement determines CE status and not vice versa results in unadjustment for indirect effects of CE on posttest achievement via pretest achievement in the estimation of its direct effects.

Clearly, a more complete paradigm for CE status would include previous year's achievement in the model so that the cause of CE selection can be directly examined. In this case, both SCAF and previous achievement would be related to pretest achievement. Alternatively, we may stipulate an ability factor that determines CE status. Because our data base lacks these kinds of information, we have to settle for a less complete system in the present model. At the same time, we shall bear in mind the ensuing specification biases and interpret the results cautiously.

Finally, we note that as the results of earlier analysis suggest some small relationship between achievement level and receipt of services, one may be inclined to hypothesize direct influences of pretest achievement on amounts of instruction received in different settings. However, we think that the correlation between achievement and receipt of services is largely attributable to the association between achievement in previous years and selection for compensatory services. Specifically, low-achieving students are selected to receive CE which emphasizes instruction by special teaching staff and in small groups. Because the total amount of time for instruction is likely limited by school hours, a substantial increase in one kind of instruction may require a decrease in other kinds. Thus, through its relationship with CE selection, previous achievement exerts some indirect influences on the allocation of time to different kinds of instruction. In turn, pretest achievement, being closely related to previous achievement, shows some correlations with time allocations.

In addition, it is possible that earlier achievement could have some direct influence on service allocations. Because we have no measure of earlier achievement prior to this study, one may be tempted to substitute pretest achievement for earlier achievement and stipulate a causal connection between pretest achievement and receipt of services. We resisted this temptation based on consideration that service allocations tended to be determined before the pretest. Instead, our service measures include the amounts of services received in the four to six weeks prior to the pretest. Therefore, the present model does not explicitly specify a direct path from pretest achievement to the service variables. The relations between earlier achievement and receipt of services, however, can be more adequately studied with the three-year data in a subsequent report.

Another concern in connection with receipt of services is the interrelationships among the three kinds of instruction. As remarked above, receipt of instruction in one kind may indirectly affect receipt of other kinds, particularly when different kinds of instruction are considered alternative methods of delivery by the school. The present model accounts for such interrelationships among the service variables primarily in terms of the roles of CE status and socio-cultural advantage factor in the allocation of services.

From our description of the model, it is obvious that we have not followed rigorously the ideal mode of a confirmatory analysis. Only when there is a well-controlled experiment, can the investigator formulate a structural model unambiguously to confirm or repudiate the causal relations stipulated by a theory. In educational research, we are far from having a good foundation for building a causal theory to explain the achievement process. This and the lack of experimental control in a survey study force us to take a more flexible position here. We construct a model based on our best knowledge and within the limitations of our data. Our objective is not to prove a theory but to improve our understanding of the factors that affect learning. Moreover, a model that looks at a very small segment (less than eight months of schooling) of the long-term achievement process can hardly be adequate for testing a comprehensive theory underlying the process. Thus, our analysis should be viewed more as an exploratory than a confirmatory, theory-testing effort. The results of our analyses are presented below.

Fit of the Path Model for Reading and Math Achievement. As remarked at the beginning of this section, goodness of fit for the model is not the focus of the analysis. In view of the large sample size (N) involved (over 10,000 in each case), we do not anticipate the model to fit well by any conventional probability levels. Nevertheless, we present the X^2statistics and the associated degrees of freedom (d.f.) in Table 3-5 for the interested reader.

To provide a reference for assessing the fit, we calculated a hypothetical N such that if a X^2 statistic were obtained with this fictitious N and the original data, the model would not be rejected at the .10 level. The hypothetical sample sizes are given in the 'Reduced N for Fit' column in Table 3-5. For reading, these entries show that if the input covariance matrices in our analyses were generated by samples of size around 500 (ranging from 349 to 827 in the six grades), instead of the original N, the model would be judged reasonably adequate. For math, the required fictitious N ranges from 637 to 997.

Our experience with the data suggests that a random sample of 500 frequently generates a covariance matrix very similar to that obtained with the entire sample. Moreover, inspection of the residual covariance matrix shows only small discrepancies between the observed and the fitted data. Consequently, we feel that the results can be useful for describing the effects of various factors on achievement and their interrelations with each other.

In passing, it may be noted that the X^2 statistic (with same d.f.) is uniformly smaller for math than for reading. Considering the negligible differences in sample sizes, the result indicates a better fit of the model for math data. This might be because reading achievement is a more complex process in that there is a greater opportunity for learning to read outside the school and thus a greater number of non-school factors to exert influences on reading achievement.

Table 3-5

Goodness of Fit of the Path Model for Reading and Math Achievement

Grade	Actual N*	χ^2*	d.f.*	Reduced N for Fit*	Reduction Factor for N*
		Reading Achievement			
1	11,920	1,215.05	26	349	34.2
2	10,997	631.11	26	620	17.7
3	10,995	659.51	25	573	19.2
4	10,846	450.68	25	827	13.1
5	11,600	727.89	25	548	21.2
6	13,253	813.00	25	560	23.6
		Math Achievement			
1	11,883	557.98	26	757	15.7
2	10,973	391.18	26	997	11.0
3	10,989	430.49	25	878	12.5
4	10,821	447.73	25	831	13.0
5	11,585	625.29	25	637	18.2
6	13,226	633.75	25	717	18.4

*Actual N = sample size for the data that generate the covariance matrix for the analysis; χ^2 = measure of fit; d.f. = degrees of freedom; Reduced N for Fit = if the same covariance matrix were based on a sample of this size, the model could not be rejected at the .10 level in light of the obtained χ^2; Reduction Factor for N = Ratio of the Actual N to the Reduced N for Fit.

The present model actually includes two parts: the measurement model for latent variables (SCAF and achievement), and the model for structural relations among the variables (latent and observed). Thus, it is convenient for us to present the results for these two parts separately.

The Constructs of Achievement and the Socio-Cultural Advantage Factor. There are three submodels describing the relationships of the observed indicators with their respective latent variables. Scores on two adjacent levels (at-level and below-level) of CTBS tests are employed as double indicators of achievement at a particular time (pretest and posttest administrations). Essentially, the two different test levels are assumed congeneric (Lord and Novick, 1968). The third latent variable is the socio-cultural advantage factor (SCAF) that represents a common factor underlying three home background variables (Race/Ethnicity, participation in free or reduced-price meals, and mother's educational attainment). The estimates of the regression coefficients in the measurement models are presented in Table 3-6.

One advantage of the measurement model for achievement is that it permits us to verify the equatability of the different levels of CTBS tests. Because vertical scale scores (VSS) derived from the equating procedure (see Technical Report 9) are used in the analysis, the regressions of the two test scores on the latent achievement variable should be the same if they have been perfectly equated. With the scale of the latent achievement variable fixed at that for the below-level test, the two levels are considered to be equated on a same scale if the regression coefficient for the at-level test is close to 1.0.

Table 3-6

Regressions of Observed Indicators on Latent Variables and Proportions of Variance Explained by the Measurement Model in the Path Analyses for Reading and Math Achievement

Grade	Posttest (POST)		Pretest (PRE)		Socio-Cultural Advantage Factor (SCAF)		
Latent Variable / Observed Indicator†	Below-Level	At Level	Below-Level	At Level	Race/Ethnicity	Free-Meals Participation	Mother's Education
				Reading Analysis			
Regression Coefficients (Lambda)							
1	1.00*	1.12	1.00*	.75	1.00*	-1.37	.81
2	1.00*	1.01	1.00*	1.22	1.00*	-1.32	.76
3	1.00*	1.33	1.00*	.95	1.00*	-1.21	.71
4	1.00*	.97	1.00*	.89	1.00*	-1.32	.77
5	1.00*	1.09	1.00*	1.01	1.00*	-1.22	.66
6	1.00*	.96	1.00*	.90	1.00*	-1.18	.66
Proportion of Variance Explained (Reliability/Communality)							
1	.80	.77	.63	.31	.31	.54	.24
2	.85	.76	.75	.85	.35	.55	.23
3	.80	.80	.94	.70	.39	.52	.22
4	.90	.86	.93	.79	.35	.56	.22
5	.87	.90	.91	.86	.39	.54	.19
6	.94	.84	.95	.81	.40	.52	.19
				Math Analysis			
Regression Coefficients (Lambda)							
1	1.00*	.97	1.00*	.82	1.00*	-1.33	.78
2	1.00*	.98	1.00*	1.01	1.00*	-1.25	.68
3	1.00*	1.61	1.00*	.96	1.00*	-1.20	.65
4	1.00*	1.06	1.00*	.75	1.00*	-1.34	.74
5	1.00*	1.35	1.00*	.98	1.00*	-1.25	.65
6	1.00*	1.06	1.00*	.91	1.00*	-1.31	.69
Proportion of Variance Explained (Reliability/Communality)							
1	.80	.75	.72	.46	.32	.53	.23
2	.81	.79	.78	.78	.38	.54	.20
3	.66	.93	.79	.81	.41	.53	.19
4	.89	.74	.96	.63	.36	.57	.21
5	.84	.77	.92	.72	.39	.55	.18
6	.86	.84	.85	.72	.37	.57	.18

†Each of the two latent variables for achievement has two indicators: Vertical Scale Scores on two adjacent levels of CTBS (below-level and at-level, see Table 1-2 of Report 9 for test levels administered). The indicators for the Socio-Cultural Advantage Factor are coded as following: Race/ethnicity (1 = Caucasian/white; 0 = otherwise); Free-Meals participation (1 = participant; 0 = non-participant); and Mother's Education (1 = High School graduate or above; 0 = otherwise).

*Fixed parameters in the model for the purpose of defining the scales of the latent variables.

As shown in the table, the two adjacent test levels have more or less equivalent scales in most cases. But there are a few exceptions. Examination of the score distribution (see Report 9) suggests that, in general, estimates of the regression coefficient substantially greater than 1.0 for the at-level test are often obtained if there are noticeable ceiling effects of the corresponding below-level test (as in the case of below-level reading pretest for grade 2, below-level posttest for grade 3 in reading, and below-level posttest for grades 3 and 5 in math). On the other hand, estimates of the regression coefficient substantially smaller than 1.0 for the at-level test indicate that the at-level test is too difficult and exhibits some floor effects (as in the case of at-level pretest for grade 1 in reading, and at-level pretest for grades 1 and 4 in math).

Another advantage of the measurement model for achievement is that separate estimates of reliability become feasible for the different test levels. In classical test theory, reliability is estimated in terms of the correlation between two parallel tests. In reality, parallel test forms are rarely attainable. Consequently, the correlation between two comparable tests implies something other than reliability. Our model, however, provides a basis for estimating the reliabilities from the error variances of test scores. These reliabilities are also presented in Table 3-6.

Examining the reliabilities, we find that tests exhibiting severe floor effects tend to have low reliabilities. For example, the estimates for the at-level pretest are as low as .31 and .46 for grade 1 in reading and math, respectively. Another low reliability is obtained for the at-level pretest for grade 4 in math (.63). It is of interest to note that all three tests with low reliabilities are neither recommended by the publisher nor by SDC to be administered at the pretest time to the respective grades.

In passing, we may also remark that based on our model, the correlation between the at-level and below-level test scores is equal to the geometric mean of their reliabilities. Referring to Table 1-8 of Report 9, the reader may verify this relationship between our reliability estimates and the projected population correlation between the test levels. This observation shows that the solution for the model as obtained with the unweighted sample data reproduces the same statistics (correlations) that have been projected to the population. Because only two tests are included in each achievement factor, the correlation between them is practically identical to the observed value (i.e, the measurement model is a perfect fit). Thus, the observed correlations between the tests based on a selected sample that involves only cases with complete data for all variables employed are not discrepant from the population statistics. This is important as it partially supports our contention that data attrition is not a serious problem in the relational analyses of this report.

Finally, we should comment that the estimated correlations between the errors for the test scores are often noticeable. However, we shall not discuss them further (and we have omitted them from the presentation of the results) because they are incorporated into the model primarily to reflect the test situation and are not of special interest to us.

Turning to the socio-cultural advantage factor, the inter-correlations among the home background variables are examined in terms of a common factor. The sign of the regression coefficient for the observed indicator on the common factor indicates the orientation of the factor-scale, while the magnitude shows the relative weight for the indicator (all these indicators are dichotomous and assume a similar scale). Additionally, the proportion of variance explainable by the common factor (the communality in the jargon of factor analysis) can be computed from the estimated variance for the unique factor and the observed variance for the indicator. The regression coefficients and communalities are also given in Table 3-6. The results for the reading and math analyses are similar, and the communalities are not large for all three variables, reflecting their low-to-moderate correlations.

Inspecting the regressions and communalities, we find that this common factor (SCAF) apparently places a greater emphasis on the economic aspect of home background than on the other two aspects. The educational aspect is the least emphasized as evidenced by the smallest communality. This is largely a consequence of the higher correlation between Race/Ethnicity and participation in free or reduced-price meals than their correlations with mother's education.

Because the observed indicators are discrete and their distributions are skewed (the projected proportion of whites, participants in free meals, and children whose mother graduated from high school are .77, .33, and .76 respectively. See Table 4-5 of Report 9 and Table 1-9 of Report 5), we expect some difficulties in fitting this part of the model. Indeed, inspection of the first-order derivatives and the residual covariance-matrix upon convergence suggests some lack of fit here. In particular, the gradients and residual covariances tend to be substantial when mother's education is involved. This phenomenon may mean that mother's education has some distinctive relation with other variables in the model that cannot be explained adequately by the postulated common factor.

Specifically, we think that mother's education may have some direct relation with achievement in addition to that shared with other home-background variables, as studies often show that it is closely related to achievement — more so than the economic variables (see Report 4). We examined this possibility by postulating a separate factor for mother's education itself. Other options that specify correlations between the unique factor for mother's education and the errors for test scores were also explored. These various modifications of the model did not result in sufficient improvement of fit to warrant the adoption of a different model. We then decided to maintain the original model for further examination of the role of mother's education in the achievement process.

The Structural Relations in the Reading Achievement Process. For ease of presentation, we discuss the results of the reading and math analyses separately. Our major interest lies in examining the paths representing the influences of CE status on receipt of services and the effects of instructional services on achievement growth. For this purpose, the model examines five regression equations simultaneously. The first equation describes the direct relations of posttest achievement with pretest achievement, CE status, the SCAF, and receipt of services. The other four describe the interrelations among the independent variables in the first equation so that their indirect effects on posttest achievement are studied.

The method of maximum likelihood estimation (see Appendix C2) is employed to obtain estimates for these regressions and the parameters in the measurement submodels simultaneously. The results for the structural regressions in the reading model are summarized in Table 3-7. The interrelationships among variables are exemplified in Figure C1-1 (see Appendix C1) with the results for grade 4. The findings from this table are discussed below.

- *The Relationship Between CE Status and Receipt of Instruction.* As may be seen from the last three columns of this table, CE status has pronounced effects on the pattern of instructional services received. CE students received substantially more hours of instruction from special teaching staff and in small classes but fewer hours of instruction from regular classroom teachers. CE students also spend considerably less time working with tutors or independently in grades 2, 3, and 6, but the difference is not as large as that observed in the other two kinds of instruction. These findings reconfirm those reported in Technical Report 5.

- *The Effects of Instruction on Reading Achievement.* The data in the second column show that special instruction, which is emphasized in CE services, generally has negligible, although positive, direct effects on posttest achievement after adjusting for differences in pretest achievement and background. The only kind of instruction showing noticeable and positive effects is regular instruction (in grades 1 and 5). Considering the total effects of the three kinds of instruction and the effects of CE status on receipt of these services together, we find little demonstrable effect of CE on achievement growth that is mediated by amounts of instruction.

- *The Role of Pretest Achievement in Determining the Posttest Achievement.* The predominant determinant of posttest achievement is pretest achievement. This finding is reflected in the extremely high correlations between the two latent variables for achievement (often known as true-score correlations). For the benefit of those readers who see relations mostly in terms of correlation coefficients, we calculated the intercorrelations among the seven variables involved in the first regression equation and present them in Table C1-7 of Appendix C1. This table shows that the correlations between pretest and posttest range from .93 in grade 1 to .98 in grade 6. These correlations are substantially higher than those obtained with test scores on the recommended test level — notably a consequence of correction for unreliabilities.

Table 3-7

Estimates of Regression Coefficients and Standard Errors (in parentheses) in the Path Model for Reading Achievement

GRADE	Predictor Variables*	Unstandardized Regression Coefficients and (Standard Errors) for Predicting				
				Hours of Instructional Services Received		
		Posttest (POST)	Pretest (PRE)	Regular (HR)	Special (HS)	Independent (HI)
	Pretest (PRE)	1.44(.04)**				
	CE Status (CE)	-1.44(.88)	-7.92(.72)**	-38.0(2.3)**	59.8(1.5)**	-10.6(1.6)**
	Socio-Cultural Advantage Factor (SCAF)	-14.96(2.72)**	55.84(1.76)**	5.4(4.7)	-3.50(3.1)	51.6(3.3)**
1	Instructional Services Received					
	Regular (HR)	.03(.004)**				
	Special (HS)	.02(.006)				
	Tutor/Independent (HI)	.02(.005)				
	Multiple R^2 (R)	.879(.938)	.356(.597)	.029(.171)	.141(.376)	.055(.234)
	Pretest (PRE)	1.16(.01)**				
	CE Status (CE)	3.20(.64)	-22.32(.88)**	-19.3(2.1)**	57.4(1.4)**	-20.7(1.4)**
	Socio-Cultural Advantage Factor (SCAF)	5.84(1.60)	68.96(2.08)**	5.5(4.3)	-.9(3.0)	26.7(3.0)**
2	Instructional Services Received					
	Regular (HR)	.01(.003)				
	Special (HS)	-.00(.005)				
	Tutor/Independent (HI)	-.01(.004)				
	Multiple R^2 (R)	.965(.982)	.389(.624)	.011(.106)	.151(.389)	.048(.219)
	Pretest (PRE)	.73(.01)**				
	CE Status (CE)	-1.68(.56)	-30.72(1.04)**	-19.2(1.9)**	60.4(1.3)**	-18.3(1.4)**
	Socio-Cultural Advantage Factor (SCAF)	8.32(1.28)**	93.36(2.40)**	-14.7(3.6)	-8.1(2.4)	6.3(2.5)
3	Instructional Services Received					
	Regular (HR)	-.00(.002)				
	Special (HS)	-.01(.004)				
	Tutor/Independent (HI)	.01(.003)				
	Multiple R^2 (R)	.909(.953)	.475(.689)	.010(.099)	.220(.469)	.025(.158)
	Pretst (PRE)	.95(.01)**				
	CE Status (CE)	-2.64(.80)	-36.00(1.36)**	-19.9(1.8)**	56.4(1.1)**	-3.3(1.2)
	Socio-Cultural Advantage Factor (SCAF)	8.72(1.68)**	114.64(3.04)**	-11.6(3.3)	-22.4(2.1)**	.2(2.3)
4	Instructional Services Received					
	Regular (HR)	.01(.005)				
	Special (HS)	.01(.007)				
	Tutor/Independent (HI)	.01(.006)				
	Multiple R^2 (R)	.917(.958)	.424(.651)	.013(.112)	.269(.519)	.000(.000)
	Pretest (PRE)	.95(.01)**				
	CE Status (CE)	-.72(.64)	-38.72(1.36)**	-20.7(1.6)**	46.4(1.1)**	-4.3(1.2)
	Socio-Cultural Advantage Factor (SCAF)	7.92(1.44)**	115.52(2.80)**	-25.9(2.7)**	-23.6(1.8)**	.3(2.0)
5	Instructional Services Received					
	Regular (HR)	.03(.005)**				
	Special (HS)	[illegible](.006)				
	Tutor/Independent (HI)	.01(.005)				
	Multiple R^2 (R)	.942(.971)	.462(.680)	.021(.147)	.223(.472)	.001(.033)
	Pretest (PRE)	.99(.01)**				
	CE Status (CE)	1.60(.72)	-37.52(1.6)**	-15.1(1.6)**	44.6(1.0)**	-7.6(1.2)**
	Socio-Cultural Advantage Factor (SCAF)	5.60(1.52)	128.08(3.04)**	-13.3(2.5)**	-24.9(1.6)**	-21.0(1.9)**
6	Instructional Services Received					
	Regular (HR)	.01(.005)				
	Special (HS)	.01(.007)				
	Tutor/Independent (HI)	.02(.006)				
	Multiple R^2 (R)	.950(.975)	.409(.640)	.008(.090)	.218(.467)	.014(.117)

*Pretest and posttest achievement factors are latent variables, each having two indicators (at-level and below-level test scores). Socio-Cultural Advantage Factor is derived from three indicators (race/ethnicity, participation in free or reduced-price meals, and mother's educational attainment). Blank entries show absence of the path.

**Magnitude of z-ratio (estimate divided by standard error) exceeds 5.

The strong correlations between pretest and posttest achievement indicate not only the direct relation between them but also the indirect relation between posttest achievement and other variables that are correlated with pretest achievement. As shown in the third column of Table 3-7, both the SCAF and CE status are important determinants of pretest achievement, and thus have substantial, indirect influences on posttest achievement. Children from more advantaged backgrounds start with higher achievement and maintain their higher achievement status at the end of the school year. On the other hand, CE students achieve at lower levels both at the pretest and at the posttest, because they were low-achieving in the previous year.

In view of the prominent role of earlier achievement in the determination of later achievement, it is unlikely that other variables will demonstrate strong direct effects on achievement growth in a single school year. More fruitful research should examine the achievement process on a long-term basis, so that the accumulated effects of educational services can be noticed (see Report 15).

- *The Role of Compensatory Education in the Achievement Process.* In general, CE status shows little additional influence on posttest achievement that is not mediated through instruction. As explained earlier, a relationship between CE status and posttest achievement, independent of instructional services, would mean that CE status can affect other educational variables that are absent in the model but have influences on achievement growth. Thus, the finding of little independent effect of CE status suggests a negligible *net* effect of other characteristics of educational process that are CE-related but are not included in our model.

- *The Influence of Student Background on Achievement.* The socio-cultural advantage factor (SCAF) demonstrates considerable influence on achievement growth in reading. In this regard, the most interesting phenomenon is that the effect of SCAF changes from negative in grade 1 to positive in other grades.

  A plausible explanation for this reversal in relationships may be as follows. At the pretest in the first grade, children from advantaged homes achieve higher scores because of greater prior opportunity to learn the test material. In contrast, children from disadvantaged homes learn during the school year when they begin to receive formal instruction. Thus, at the posttest administration, the disadvantaged children will show a greater growth. This explanation is appealing particularly because the tests employed in the two administrations cover similar skills (in fact, the at-level pretest and the below-level posttest are identical). For these reasons, a negative relationship between the SCAF and achievement growth is obtained. However, this initial 'benefit' for the disadvantaged children dissipates soon after a year of formal schooling. In later years, the relationship between SCAF and achievement growth returns to the normal expectation of greater growth for advantaged children.

- *The Relationship Between Student Background and Receipt of Instruction.* Our last remark on the data presented in Table 3-7 concerns the effects of the SCAF on allocation of services. In grades 3 through 6, the relationship between SCAF and amount of special instruction is substantially negative, having controlled for the differences in CE status. Although not as pronounced, SCAF is also negatively related to amount of regular instruction in these grades. This result appears counter-intuitive because we normally think that children from advantaged homes are likely to attend schools that provide more intensive services. To understand this finding better, we offer a possible explanation on the basis of the relation between SCAF and achievement status. As explained in a preceding section, there may be a tendency to allocate services according to educational need within schools. Student's educational need is determined based on his/her previous achievement, which has not been measured in this study, but is closely related to SCAF. As the direct influence of earlier achievement on receipt of services is not incorporated into the model due to lack of required data, it is reflected in the relationship between SCAF and the service variables.

The fact that only 19 to 25 percent of the students are selected to receive CE services in reading (see Table 3-1 of Report 9) suggests that schools may be inclined to provide more instruction to low-achieving students as an additional remedial action. Children from disadvantaged homes are likely to have greater educational need and thus tend to receive more instruction even if they are not formally selected to receive CE.

The reader may recall that the correlation analysis presented earlier in this chapter also reveals some evidence for the practice of allocating services according to achievement status. This practice and the CE-selection policy together result in an inverse relationship between receipt of services and achievement. The inverse relationship tends to mask the effects of services on achievement growth. As long as there are differential effects of services according to prior achievement, the linear model cannot adequately account for the differences. This problem is potentially responsible for our inability to find substantial effects of services on achievement growth.

Finally, we note that the combined effects of CE status and the SCAF on receipt of services are generally small, as indicated by the multiple correlations. Among the three kinds of instructional services, amount of special instruction has the strongest relationship with CE status and SCAF.

The Structural Relations in the Math Achievement Process. The results of the structural-relation analysis for math achievement are mostly similar to those obtained in reading. Estimates for the parameters in the five simultaneous regression equations are presented in Table 3-8. The results for grade 4 are illustrated graphically in Figure C1-2 of Appendix C1. The correlations among the seven variables involved in these equations are estimated with the model and presented in Table C1-7 of the same Appendix. The findings from Table 3-8 are discussed below.

- *The Relationship Between CE Status and Receipt of Instruction.* Looking at the regressions of the three service variables, the results show that CE students receive considerably more special instruction than non-CE students. But, at the same time, CE students also receive less regular instruction. Combining all three kinds of instruction, the net effect is for CE students to receive more instruction in total in grades 3 through 6. The net effect of CE status on total amount of instruction received is negligible in the lower two grades. As in reading, these findings reconfirm those obtained in Report 5.

- *The Effects of Instruction on Math Achievement.* Examining the second column of Table 3-8, we find that amount of special instruction has positive, but insubstantial, direct effects on posttest achievement. The only exception is found in grade 3, where the estimate of this path coefficient is negligibly negative. By comparison, regular instruction has noticeable, positive effects on achievement growth in grades 2 through 5. Because CE services are characterized by receipt of more special instruction, this result suggests that amount of instruction is not likely a primary factor for explaining the effects of CE on achievement growth.

  An interesting observation upon the relationships between amount of instructional services and achievement growth is that all three kinds of instruction demonstrate sizeable effects in grade 4. We suspect that the introduction of more complex math concepts at this stage of schooling enhances the role of instruction in learning.

- *The Role of Pretest Achievement in Determining the Posttest Achievement.* The relationship between pretest and posttest achievement is not as strong in math as in reading. However, pretest achievement remains the predominant factor in the determination of posttest achievement. Simple correlations between the two latent variables for achievement range from .87 in grade 1 to .93 in grade 5 (see Table C1-7 in Appendix C1). Again, the SCAF and CE status have considerable, indirect influences on posttest achievement because of their relationships with pretest achievement.

  The SCAF is positively and substantially related to pretest achievement; but the relationship is less prominent in math than in reading. This observation conforms to the popular belief that

Table 3-8

Estimates of Regression Coefficients and Standard Errors (in parentheses) in the Path Model for Math Achievement

GRADE	Predictor Variables*	Unstandardized Regression Coefficients and (Standard Errors) for Predicting				
				Hours of Instructional Services Received		
		Posttest (POST)*	Pretest (PRE)	Regular (HR)	Special (HS)	Independent (HI)
1	Pretest (PRE)	1.16(.02)**				
	CE Status (CE)	.08(.96)	-2.24(1.04)	-19.2(1.4)**	26.6(.8)**	-10.6(1.1)**
	Socio-Cultural Advantage Factor (SCAF)	.40(1.92)	55.60(1.84)**	-.9(2.2)	-19.3(1.3)**	12.0(1.7)**
	Instructional Services Received					
	Regular (HR)	.02(.006)				
	Special (HS)	.02(.012)				
	Tutor/Independent (HI)	.04(.008)**				
	Multiple R^2 (R)	.765(.875)	.242(.491)	.018(.134)	.160(.400)	.022(.150)
2	Pretest (PRE)	1.00(.01)**				
	CE Status (CE)	-1.20(.88)	-4.64(1.12)	-21.4(1.4)**	22.4(.8)**	-1.9(1.0)
	Socio-Cultural Advantage Factor (SCAF)	11.44(1.68)**	63.36(2.08)**	-17.9(2.3)**	-13.2(1.3)**	8.3(1.6)**
	Instructional Services Received					
	Regular (HR)	.05(.006)**				
	Special (HS)	.01(.011)				
	Tutor/Independent (HI)	-.02(.009)				
	Multiple R^2 (R)	.793(.891)	.229(.478)	.023(.152)	.117(.342)	.004(.064)
3	Pretest (PRE)	.67(.01)**				
	CE Status (CE)	1.20(.64)	-16.72(1.28)**	-15.2(1.3)**	32.6(.8)**	-3.6(1.0)
	Socio-Cultural Advantage Factor (SCAF)	7.04(1.20)**	72.00(2.24)**	-18.0(2.1)**	-10.6(1.2)**	14.9(1.6)**
	Instructional Services Received					
	Regular (HR)	.04(.006)**				
	Special (HS)	-.02(.009)				
	Tutor/Independent (HI)	.03(.006)				
	Multiple R^2 (R)	.778(.882)	.283(.532)	.017(.130)	.191(.437)	.019(.139)
4	Pretest (PRE)	.80(.01)**				
	CE Status (CE)	-6.88(.96)**	-23.28(1.60)**	-14.6(1.4)**	32.5(.9)**	8.0(1.1)**
	Socio-Cultural Advantage Factor (SCAF)	16.08(1.84)**	98.72(2.96)**	-11.3(2.2)**	-16.4(1.5)**	10.2(1.8)**
	Instructional Services Received					
	Regular (HR)	.07(.009)**				
	Special (HS)	.08(.011)**				
	Tutor/Independent (HI)	.06(.010)**				
	Multiple R^2 (R)	.816(.903)	.265(.514)	.010(.102)	.151(.388)	.008(.092)
5	Pretest (PRE)	.77(.01)**				
	CE Status (CE)	-.16(.80)	-26.32(1.60)**	-17.1(1.6)**	32.3(1.0)**	1.0(1.2)
	Socio-Cultural Advantage Factor (SCAF)	6.88(1.44)	96.48(2.64)**	-8.8(2.2)**	-18.7(1.4)**	1.3(1.7)
	Instructional Services Received					
	Regular (HR)	.06(.006)**				
	Special (HS)	.04(.009)				
	Tutor/Independent (HI)	.04(.008)				
	Multiple R^2 (R)	.858(.927)	.308(.555)	.010(.102)	.139(.373)	.000(.000)
6	Pretest (PRE)	1.02(.01)**				
	CE Status (CE)	2.40(1.20)	-31.60(1.84)**	-28.1(1.6)**	32.4(.8)**	4.8(1.1)
	Socio-Cultural Advantage Factor (SCAF)	9.68(2.00)	103.36(3.04)**	-2.9(2.3)	-16.7(1.2)**	.0(1.7)
	Instructional Services Received					
	Regular (HR)	.04(.010)				
	Special (HS)	.03(.014)				
	Tutor/Independent (HI)	.04(.012)				
	Multiple R^2 (R)	.852(.923)	.252(.502)	.026(.162)	.161(.401)	.002(.040)

*Pretest and posttest achievement factors are latent variables, each having two indicators (at-level and below-level test scores). Socio-Cultural Advantage Factor is derived from three indicators (race/ethnicity, participation in free or reduced-price meals, and mother's educational attainment). Blank entries show absence of the path.

**Magnitude of z-ratio (estimate divided by standard error) exceeds 5.

math skills are largely learned through schooling, while there are numerous occasions outside the school where learning to read takes place. On the basis of this belief, the background factor is expected to be more strongly related to reading achievement than to math achievement.

Independent of the background factor, CE status exhibits a negative relationship with pretest achievement, especially in grades 3 through 6. As in reading, this negative relationship is indicative of the low-achieving status of CE students before participation and the transmission of earlier achievement to pretest achievement.

- *The Role of Compensatory Education in the Achievement Process.* CE status does not exhibit much direct effect on posttest achievement except in grade 4. In this grade, the estimate of the regression coefficient for CE status is noticeably negative. As emphasized earlier in this chapter, CE status, being a dichotomous label for the students, can have meaningful effects on achievement growth only through its relationships with variables that differentiate CE and non-CE students. With this in mind, we think that the direct effect of CE status in grade 4 may represent at least two sources: (1) the combined effect of all aspects of educational experiences of CE students that are not correlated with amounts of instructional services received; (2) the influence of background characteristics that are not subsumed under the SCAF but are different between CE and non-CE students. Therefore, unless there is further evidence, we should not draw a hasty conclusion that participation in CE has harmful effects in this grade. We suspect that the isolated incidence of a sizeable, negative coefficient for CE status could be just a finding by chance.

- *The Influence of Student Background on Achievement.* The direct effects of SCAF on posttest achievement are substantial and positive in all grades but grade 1; the effect in grade 1 is negligible. This finding is different from that in reading, where the effect of SCAF is significantly negative in grade 1. This difference may be explained by the differential opportunity to learn reading and math skills outside the school. As opposed to reading, pre-school learning in math skills is not prevalent. Therefore, the benefit of exposure to formal and structured learning in math is enjoyed almost equally by children of all backgrounds. However, as the skills become more complex, the SCAF begins to show some positive relationship with learning.

- *The Relationship Between Student Background and Receipt of Instruction.* The direct effects of SCAF on receipt of services are noticeably negative in both regular and special instruction, the latter in particular. This finding supports the contention that, disregarding CE status, there is also a practice of distributing more math services to students with greater need. Except for special instruction, the combined relationship of CE status and SCAF with receipt of services is weak.

Conclusions from the Path-Model Analysis. The present analyses employing a general path-model provide only weak evidence for positive effects of instructional time on achievement. In particular, amount of special instruction, which characterizes CE services, does not have appreciable effects on achievement growth. Therefore, we are not optimistic that provision of more special instruction alone will help close the achievement gap between CE students and their non-disadvantaged peers. To our disappointment, we find little evidence of success for the strategy of offering CE students more labor-intensive services in order to overcome their achievement deficit. Clearly, the fact that special instruction for CE students exists is not enough to show the success of CE. We need to investigate further what takes place during the special instruction to know what elements of instruction are beneficial to achievement.

An Analysis-of-Covariance Model for Examining the Role of CE and Instruction in the Achievement Process

In the preceding path analysis, the LISREL model was applied to the entire sample and a dummy variable indicating CE status was employed to distinguish CE from non-CE students. With this

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approach, the differences between CE and non-CE students are examined in terms of the path coefficients for the CE-status variable. Because the majority of non-CE students achieve at a higher level and are expected to have a faster growth rate than CE students, it is inappropriate to compare their differences in posttest achievement directly to judge the effectiveness of CE. Although the initial differences between groups have been statistically adjusted by including the background and pretest-achievement variables in the model, the adjustments are often inadequate when the differences are large. For this reason, we were cautious not to interpret the coefficient for the dummy variable as a measure of the effect of CE.

Another difficulty in analyzing data from the total sample lies in the assessment of the effects of instructional services on achievement growth. Because of the selection bias and a tendency for schools to allocate services according to educational need regardless of CE status, amount of services received by the students is inversely related to their achievement level. As remarked earlier, this inverse relationship between achievement and service allocation tends to mask the effects of instructional services on achievement growth.

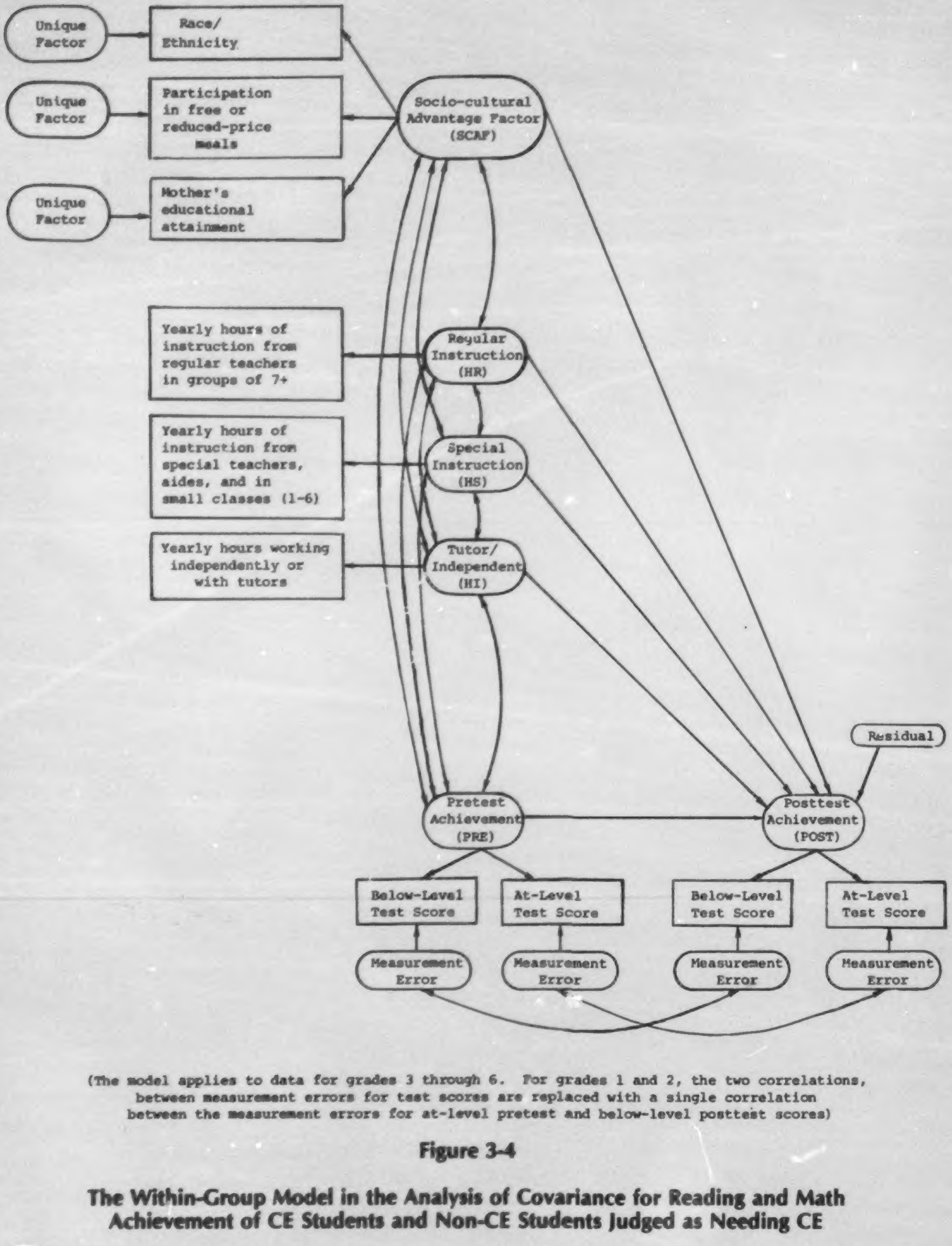
To overcome these problems in the evaluation of the effects of CE and instructional services, further analysis will employ a restricted sample that excludes non-CE students who are judged as not needing CE. The non-CE students remaining in the sample are more similar to the CE students with respect to achievement level and educational need (see Chapter 2). They are thus chosen to serve as comparison groups in many of our analyses.

For the purpose of comparing the effects among different CE programs, CE students are divided into three groups according to the programs that serve them: Title I students in Title I schools, other-CE students in Title I schools, and other-CE students in other-CE schools. The comparison non-CE students are divided into two groups depending on whether CE is provided in the schools they attend: needy non-CE students in CE schools and needy non-CE students in non-CE schools. This distinction is made in order to control for potential school differences in the comparison between CE and non-CE students. In total, there are five student groups involved in the present analysis.

A common approach to estimating group differences and effects of independent variables in this case is the ANCOVA (analysis of covariance) design. Because measurement errors pose a serious problem in the ANCOVA (see discussions in Chapter 2), Sörbom (1978) has proposed to perform ANCOVA with latent variables so as to solve the problem of measurement errors directly. Borrowing the parlance in test theory, this analysis may be called 'true-score ANCOVA.' Essentially, a similar LISREL model is applied to the groups in the design simultaneously.

Description of the ANCOVA Model. The basic within-group model is depicted in Figure 3-4. The measurement models for the three latent variables with multiple indicators are identical to those specified in Figure 3-3 for the earlier path analysis. These three latent variables are: pretest achievement, the socio-cultural advantage factor (SCAF), and posttest achievement. Pretest achievement, SCAF, and the three variables measuring instructional services comprise the independent variables (often known as covariates in ANCOVA) that determine the posttest achievement. Unlike the previous path analysis, the direction of the interrelationships among the independent variables are not of particular concern here. Therefore, these relationships are examined simply in terms of intercorrelations. In this way, the analysis is focused on the estimation of the direct effects of amounts of instruction on achievement growth.

The LISREL program ordinarily analyzes the covariance matrices and hence does not deal with means. However, in an ANCOVA situation, we are also interested in comparisons of differences in adjusted means (i.e., intercepts, when within-group regression surfaces are parallel) in order to assess the group (treatment) effects. For this purpose, a variable having a constant value of one is incorporated into the model so that the intercepts of the regression equations and the means of the latent variables can be estimated explicitly by analyzing the moment matrices. The 'constant' variable is not shown in the figure. Nevertheless, the complete model specified in the LISREL analysis actually includes direct paths from this 'constant' term to each of the five covariates and to


Unique Factor
Race/ Ethnicity
Unique Factor
Participation in free or reduced-price meals
Unique Factor
Mother's educational attainment
Socio-cultural Advantage Factor (SCAF)
Yearly hours of instruction from regular teachers in groups of 7+
Regular Instruction (HR)
Yearly hours of instruction from special teachers, aides, and in small classes (1-6)
Special Instruction (HS)
Yearly hours working independently or with tutors
Tutor/ Independent (HI)
Residual
Pretest Achievement (PRE)
Posttest Achievement (POST)
Below-Level Test Score
At-Level Test Score
Below-Level Test Score
At-Level Test Score
Measurement Error
Measurement Error
Measurement Error
Measurement Error

(The model applies to data for grades 3 through 6. For grades 1 and 2, the two correlations, between measurement errors for test scores are replaced with a single correlation between the measurement errors for at-level pretest and below-level posttest scores)

Figure 3-4

The Within-Group Model in the Analysis of Covariance for Reading and Math Achievement of CE Students and Non-CE Students Judged as Needing CE

posttest achievement. The estimates of the coefficients for these hidden paths correspond to the group means for the covariates and the intercepts in the within-group regression equations, respectively.

It is important to note that the moment matrix should be analyzed instead of the covariance matrix. The moment matrix contains means for the observed variables in the row corresponding to the 'constant' variable. Hence, the mean differences among groups can be studied in the model. This option of LISREL absorbs the feature of COFAMM (Sörbom and Jöreskog, 1976) that allows explicit estimates of factor means. Consequently, we can compare the means of the covariates among groups to describe their associations with CE status.

The intercept (which is a function of the means and regression coefficients) can also be compared among groups to evaluate the direct affects of CE status that are independent of the effects of instructional services.

The model described above serves as the basis for testing hypotheses on the effects of CE and the covariates on achievement growth. Mathematical formulations of this model are provided in Appendix C2. To facilitate later references, we designate this basic model as *Model A*. Two sets of constraints are then imposed on the basic model for testing the usual ANCOVA assumption of homogeneous within-group regressions. This assumption of parallel regressions is examined hierarchically in two parts: for the pretest achievement and SCAF first, and then for the three service variables. Thus *Model A* is modified sequentially according to the two hypotheses to be tested to form *Model B* and *Model C* as follows:

- *Model B* imposes on Model A the constraints that the path coefficients from pretest achievement and SCAF to posttest achievement are invariant over groups (for convenience, we refer to this set of constraints as H_B where H stands for hypothesis).

- *Model C* imposes on Model B the constraints (referenced as H_C) that the path coefficients from the three service variables to posttest achievement are invariant over groups.

Thus, the validity of complete parallelism of the regressions can be assessed by the difference in the X^2 statistic between Model C and Model A.

Assuming the within-group regressions are parallel, we then fit another model *(Model D)* to the data in order to test the equality of adjusted group means:

- *Model D* imposes on Model C the constraints (H_D) that the intercepts (i.e., the coefficients for the paths from the 'constant' variable to posttest achievement) are invariant over groups.

In summary, four LISREL models (A-D) are fitted for the five analysis groups simultaneously. Our objective is to examine both the within-group and pooled path coefficients (estimated with Models A and C, respectively) for the service variables. These coefficients signify the direct effects of amount of instruction on achievement growth. This information and that about the differences in receipt of services among the groups are then considered jointly to evaluate the role of instructional services in effecting the achievement growth of CE students.

In addition, the adjusted means for posttest achievement are compared among the groups in order to assess any remaining effects of CE on achievement growth, controlled for differences in background, prior achievement, and services received.

Another use of the results is to compare the mean differences in pretest achievement and SCAF among the groups. Such comparisons provide us with information about the extent to which CE is targeted at the most disadvantaged children among the ones with some educational need.

Fit of the ANCOVA Model and Test of Hypothesis. Though the sample is reduced in the present analyses by the exclusion of non-CE students not in need of CE, it is still quite large (ranging from around 3,200 to 4,500 for reading and math). Our interest is, again, not in the absolute fit of the basic model per se. Nevertheless, the X^2-statistics and the associated degrees of freedom are presented in Table 3-9 as supplemental information. We follow the strategy adopted in Table 3-5 and calculate the fictitious N's for Model A to be judged adequate at the .10 level. These values (obtained by assuming a proportional reduction of N in the five groups) are given in the table to help the readers assess the usefulness of the model.

The reduced size for the total sample in general exceeds 1,000. Inspection of the discrepancies between the observed and estimated moments reveals no large values. On these bases, we consider the model reasonably satisfactory for our purpose.

Regarding the appropriateness of the model, it should be noted that some difficulties were experienced in obtaining solutions with the LISREL program. Because the program fails to avoid parameter estimates beyond acceptable ranges, it sometimes converges to estimates that are inadmissible on conceptual grounds. For instance, negative estimates for the disturbance variances in the regression equations, and for error (unique) variances in the measurement models (commonly known as the Heywood case) were obtained in some analyses with the original Model A. Occasionally, estimates of correlated errors for the achievement variables were also found to be inadmissible (with correlations exceeding 1.0 in magnitude).

To overcome these problems, Model A was modified by constraining the troubled elements to be invariant over groups whenever inadmissible estimates were obtained. If the problem persisted with this action, we then tried other avenues such as constraining the problematic parameter to zero (i.e., removing the path; Jöreskog, 1969). With some effort, we eventually were able to arrive at a model in each case that resulted in proper estimates for all parameters. A summary of the required revisions for the original Model A is given in Table C1-8 of Appendix C1. These revisions were also incorporated into the corresponding Models B, C, and D.

Additionally, Table 3-9 also presents the results of hypothesis testing on the assumption of parallel regressions and on the group differences in adjusted means for posttest achievement. There are no important violations of the assumption of parallel regressions with respect to the pretest achievement and SCAF (see tests for H_B). On the other hand, within-group regressions of posttest achievement on the services variables are often significantly non-parallel at the .01 level (see tests for H_C). For this reason, both the within-group and pooled estimates of these regression coefficients will be examined when we later discuss the effects of instructional services.

However, in light of the large sample involved and the moderate group differences in covariate means (see Table 3-11), we proceed to test the equality of adjusted posttest means by fitting Model D. As shown in the table, appreciable differences are found for grades 1 and 2 in reading, and for all grades but grade 2 in math. Such differences can be interpreted as CE effects, independent of instructional services. Further discussion of this result is postponed to a later part of this section where the adjusted means are examined explicitly.

The Measurement of Achievement and the Socio-Cultural Advantage Factor. An important feature of the measurement model is that the regressions of the observed variables on their respective latent variables are assumed identical for the five groups. This choice is forced upon us because, if the regressions are allowed to vary across groups, a conceptual difficulty arises. That is, changes in these regressions would mean that different metrics may be applied to measure the characteristics of these groups (Rock, Werts, and Flaugher, 1978).

Table 3-10 summarizes the results of fitting the measurement submodels. As remarked earlier, the analysis of the moment matrix enables us to estimate the intercepts in the regressions of the observed indicators on the latent variables. In the identification conditions for the present model, we have set the means of the latent variables at zero for the group of Title I students. Consequently, these intercepts in effect become estimates of the means of the observed variables for this group. Looking at these intercepts, we find that, with few exceptions, the at-level and below-level tests differ little in measuring mean group performance.

Table 3-9

Goodness of Fit and Hypothesis Testing of the ANCOVA Model for Reading and Math Achievement of CE Students and Non-CE Students Judged as Needing CE

	Hypothesis Testing Measures of Significance	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6
READING ANALYSIS	Goodness of Fit of Model A (Basic Model)†						
	Chi-square (degrees of freedom)	974.5(146)	662.6(146)	669.6(141)	505.9(137)	481.6(137)	565.3(141)
	Range and (Total) of actual group sizes (N)	324-1,710 (4,298)	325-2,008 (4,526)	337-1,955 (4,306)	352-1,469 (3,898)	274-1,366 (3,807)	365-1,506 (4,109)
	Reduction Factor of N to render χ^2 for Model A insignificant at the .10 level	5.0	3.9	4.1	3.2	3.0	3.5
	Range and (Total) of reduced group sizes	56-295 (741)	83-515 (1,161)	82-477 (1,050)	110-459 (1,218)	91-455 (1,269)	104-430 (1,174)
	Difference in χ^2 (d.f.) for Hierarchical Testing of Hypothesis on ††:						
	H_B - Invariance of Regressions of POST on PRE, and SCAF (Model B versus Model A)	19.29(8)	26.07(8)	19.27(8)	12.51(8)	3.19(8)	19.49(8)
	H_C - Invariance of Regressions of POST on HR, HS, and HI (Model C versus Model B)	27.66(12)*	50.26(12)*	6.40(12)	26.99(12)*	15.51(12)	20.14(12)
	H_D - Equality of Adjusted Means of POST among groups (Model D versus Model C)	16.03(4)*	25.32(4)*	4.60(4)	3.11(4)	13.84(4)	9.44(4)
MATH ANALYSIS	Goodness of Fit of Model A (Basic Model)†						
	Chi-square (degrees of freedom)	604.7(142)	471.5(142)	543.9(142)	505.1(137)	520.7(141)	475.6(137)
	Range and (Total) of actual group sizes (N)	234-1,046 (3,203)	200-1,043 (3,217)	284-1,092 (3,425)	294-941 (3,255)	279-1,063 (3,342)	280-1,204 (3,598)
	Reduction factor of N to render χ^2 for Model A insignificant at the .10 level	3.7	2.9	3.3	3.2	3.2	3.0
	Range and (Total) of reduced group sizes	63-283 (866)	69-360 (1,109)	86-331 (1,038)	92-294 (1,017)	87-332 (1,044)	93-401 (1,199)
	Difference in χ^2 (d.f.) for Hierarchical Testing of Hypothesis on ††:						
	H_B - Invariance of Regressions of POST on PRE, and SCAF (Model B versus Model A)	15.30(8)	21.57(8)*	19.88(8)	15.00(8)	5.05(8)	24.79(8)*
	H_C - Invariance of Regressions of POST on HR, HS, and HI (Model C versus Model B)	55.24(12)*	17.00(12)	29.31(12)*	80.40(12)*	17.29(12)	27.26(12)*
	H_D - Equality of Adjusted Means of POST among groups (Model D versus Model C)	39.15(4)*	8.29(4)	53.06(4)**	30.60(4)*	21.34(4)*	17.98(4)*

†Please refer to the text for a description of the Model. The reduction factor for N to render χ^2 for the model insignificant at the .10 level is obtained as the ratio of the observed χ^2 to the critical value. If the data were generated from samples of the reduced sizes, the model would not be rejected at the .10 level.

††Three sets of restrictions (corresponding to H_B, H_C, and H_D respectively) were introduced to the basic model in hierarchical order to yield Models B, C, and D for testing the homogeneity of regressions and equality of adjusted means in the ANCOVA model. Each hypothesis is tested by comparing the two adjacent models differing only in the restrictions specified in the hypothesis. Abbreviations for the variables are: POST = latent variable for posttest achievement; PRE = latent variable for pretest achievement; SCAF = latent variable for the Socio-cultural advantage factor, HR = yearly hours of instruction received from regular teachers in groups of 7 or more; HS = yearly hours of instruction received from regular teacher in small groups (1-6) or from special teachers and aides; HI = yearly hours working with tutor or independently.

*Indicates that the hypothesis is rejected at the .01 level on the basis of actual group sizes. The critical values for d.f. = 4, 8, and 12 are 13.28, 20.09, and 26.22, respectively.

**Indicates that the hypothesis is rejected at the .01 level if the data were obtained with the reduced group sizes.

Table 3-10

Regressions of Observed Indicators on Latent Variables in the ANCOVA Model for Reading and Math Achievement of CE Students and Non-CE Students Judged as Needing CE (From the Basic Model)†

	Latent Variable	Posttest (POST)		Pretest (PRE)		Socio-cultural Advantage Factor (SCAF)		
	Observed Indicator††	Below Level	At-Level	Below Level	At-Level	Race/ Ethnicity	Free-Meals Participation	Mother's Education
READING ANALYSIS	Regression Coefficients (Lambda)**							
	Grade 1	1.00*	.84	1.00*	.51	1.00*	-1.27	.70
	Grade 2	1.00*	.81	1.00*	.97	1.00*	-1.28	.67
	Grade 3	1.00*	1.06	1.00*	.67	1.00*	-1.25	.61
	Grade 4	1.00*	.90	1.00*	.74	1.00*	-1.34	.61
	Grade 5	1.00*	1.03	1.00*	.92	1.00*	-1.09	.47
	Grade 6	1.00*	.94	1.00*	.78	1.00*	-1.02	.43
	Intercept (nu)**							
	Grade 1	388.95	384.15	326.75	336.55	.47	.64	.56
	Grade 2	427.83	428.27	383.47	381.91	.50	.61	.60
	Grade 3	453.66	451.90	419.82	418.82	.49	.63	.57
	Grade 4	474.95	474.31	443.15	448.51	.51	.62	.55
	Grade 5	494.78	494.42	468.78	468.10	.47	.64	.55
	Grade 6	518.14	518.94	490.42	494.46	.42	.66	.54
MATH ANALYSIS	Regression Coefficients (Lambda)**							
	Grade 1	1.00*	.85	1.00*	.64	1.00*	-1.34	.72
	Grade 2	1.00*	.86	1.00*	.94	1.00*	-1.19	.61
	Grade 3	1.00*	1.25	1.00*	.82	1.00*	-1.08	.47
	Grade 4	1.00*	1.00	1.00*	.71	1.00*	-1.47	.64
	Grade 5	1.00*	1.15	1.00*	.89	1.00*	-1.14	.46
	Grade 6	1.00*	1.07	1.00*	.81	1.00*	-1.11	.42
	Intercept (nu)**							
	Grade 1	373.02	372.78	311.74	317.38	.34	.77	.48
	Grade 2	420.48	418.32	367.80	370.12	.39	.72	.54
	Grade 3	463.69	472.37	411.65	406.65	.36	.73	.53
	Grade 4	504.10	503.54	450.50	456.54	.47	.67	.55
	Grade 5	531.97	538.21	490.93	490.85	.42	.69	.54
	Grade 6	569.49	573.69	524.89	525.13	.41	.69	.54

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† The estimates of the regressions are obtained with the basic Model (Model A). The results with the other three models are similar. Please refer to the text for explanations of the Model.

†† Each of the two latent variables for achievement has two indicators: vertical scale scores on two adjacent levels of CTBS (below-level and at-level, see Table 1-2 of Technical Report 9 for test levels administered). The socio-cultural advantage factor has three indicators. For coding of these indicators, see Table 3-6.

* Fixed parameters in the model for the purpose of defining the scales of the latent variables.

** Regressions of observed indicators on latent variables are assumed to be invariant over the analysis groups. Because of the identification conditions imposed on the model, the intercepts are in effect estimates of means for Title I students in Title I schools.

The intercepts for the three home-background variables provide the estimates of proportions of Title I students who are White, who participate in meal programs, and whose mothers graduated from high school, respectively. Comparing these proportions with the projected population values (.77, .33, and .76, respectively; see Reports 5 and 9), we find that Title I programs serve disproportionately high percentages of minorities, participants in meal programs, and children whose mothers did not graduate from high school. The differences are very substantial, especially with respect to participation in free or reduced-price meal programs (the proportion for Title I students is sometimes more than twice that in the general population).

Examination of the regression coefficients (lambda) of the test scores on the achievement factor reveals a slightly different picture from that in the analysis for the entire sample (see Table 3-6). The present data more frequently reflect test-floor effects than ceiling effects, as might be expected for low-achieving students. This phenomenon is especially noticeable at the pretest administration. With few exceptions, estimates of lambda for the at-level pretests are substantially lower than 1.0, the value assumed if the two test levels are equivalent. As noted previously, such results are normally obtained when the at-level test is too difficult.

To study further the effects of test level, we computed the within-group reliabilities for each test level at the pretest administration. These reliabilities are shown in Table C1-9 of Appendix C1, where it may be seen that for grade 1, the reliabilities of the at-level tests are extremely low in both reading and math for all groups. In general, the reliabilities for the at-level tests are lower than those for the corresponding below-level tests. Most important, the reliabilities are appreciably lower for those students whose achievement levels are at the low end of the distribution than for the general population (see Table 3-6). These observations confirm the concern of functional-level testing. The selection of a better test level, based on the score distribution within each grade and each school, to furnish the scores for our analyses proves to be an important improvement of this study over the evaluation studies. This practice alleviates the potential test-floor effects on the performance of the disadvantaged students and thereby increases the validity of the evaluation.

The factor patterns for the background variables are similar to those obtained in Table 3-6. The SCAF represents primarily the economic and cultural aspects of socio-background. As in the path analysis, information from the technical outputs of the LISREL program (e.g., the first-order derivatives and residual moments) suggests a slight inadequacy of the model in examining the effects of mother's education in terms of the common background factor. Again, attempts to improve this situation did not have much payoff. Therefore, we adopted the model without further modifications.

Results of the Analysis Based on the ANCOVA Model. The results of fitting the ANCOVA model are discussed in three ways: mean group differences with respect to the independent variables, within-group and pooled estimates of the path coefficients, and group differences in adjusted means for posttest achievement.

(1) Estimated Means of the Covariates

For convenience, the metrics of the covariates are defined by setting the origins at the respective means for Title I students. The scales for the latent variables in the model are selected to be the same as one of their respective indicators. Specifically, the achievement factors are measured in terms of the scale of the below-level tests, while the SCAF assumes a scale between 0 and 1 (as for Race/Ethnicity). Thus, means for the achievement factors are expressed in VSS units, whereas means for SCAF have the meaning of proportions. For instructional services, the observed variables (expressed as deviations from the means for Title I students) are entered directly into the analysis as covariates.

Means for the five covariates are presented in Table 3-11 by groups. The reader is reminded that the means for Title I students are always zero by virtue of the metrics chosen in the analysis. The pattern of group differences with respect to the covariates are similar between reading and math.

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Table 3-11

Group Differences in Means for Covariates Employed in the ANCOVA With Latent Variables for Reading and Math Achievement

Grade	Student Group**	Estimated Means for Covariates in Reading Analysis*					Estimated Means for Covariates in Math Analysis*				
		PRE	SCAF	HR	HS	HI	PRE	SCAF	HR	HS	HI
1	TI/TI	0.00	.00	0.0	0.0	0.0	0.00	.00	0.0	0.0	0.0
	OCE/TI	11.12	.13	11.5	-27.4	-1.1	17.52	.23	-4.4	-27.0	.1
	OCE/OCE	7.24	.20	-30.0	-8.9	3.5	10.44	.23	-9.1	-12.0	12.1
	NNCE/CE	-2.96	.12	16.7	-46.6	7.5	-7.64	.14	7.6	-32.3	8.8
	NNCE/NCE	-7.28	.11	46.4	-61.7	9.3	-3.16	.23	18.8	-31.6	11.8
2	TI/TI	0.00	.00	0.0	0.0	0.0	0.00	.00	0.0	0.0	0.0
	OCE/TI	24.52	.14	10.5	-31.5	4.0	21.52	.17	-11.3	-16.7	3.4
	OCE/OCE	7.48	.19	-22.2	-11.4	22.7	15.40	.19	-7.5	-.9	6.3
	NNCE/CE	2.64	.08	9.9	-44.9	22.2	-4.04	.13	16.7	-18.3	5.0
	NNCE/NCE	-1.88	.11	11.7	-65.3	10.9	-11.12	.17	19.6	-31.5	-7.1
3	TI/TI	0.00	.00	0.0	0.0	0.0	0.00	.00	0.0	0.0	0.0
	OCE/TI	22.24	.03	1.6	-23.5	10.6	17.92	.15	9.8	-19.0	2.5
	OCE/OCE	9.44	.18	-12.1	-2.1	2.9	16.44	.26	9.7	-14.1	20.5
	NNCE/CE	7.28	.09	1.6	-42.3	17.9	-3.60	.14	7.5	-30.5	4.7
	NNCE/NCE	-1.04	.08	33.2	-56.4	12.6	-4.12	.20	21.4	-42.1	10.8
4	TI/TI	0.00	.00	0.0	0.0	0.0	0.00	.00	0.0	0.0	0.0
	OCE/TI	20.56	.08	-11.3	-14.9	1.9	24.32	.08	-3.4	-13.1	14.8
	OCE/OCE	18.96	.10	-13.4	-20.2	10.3	20.12	.10	-15.8	-12.5	19.5
	NNCE/CE	10.08	.08	7.3	-49.5	5.9	-.36	.07	6.1	-30.6	-4.3
	NNCE/NCE	5.40	.09	24.6	-60.5	-13.1	.20	.08	16.5	-43.3	-1.8
5	TI/TI	0.00	.00	0.0	0.0	0.0	0.00	.00	0.0	0.0	0.0
	OCE/TI	20.84	.07	-7.1	-18.0	11.3	27.12	.09	-1.1	-30.9	12.5
	OCE/OCE	10.16	.11	-.2	-14.5	8.8	7.28	.10	-22.0	-22.1	16.3
	NNCE/CE	13.40	.02	11.4	-44.9	9.7	3.68	.02	9.9	-40.8	9.1
	NNCE/NCE	-3.44	.11	19.6	-49.5	-4.7	-4.64	.15	5.1	-43.1	1.4
6	TI/TI	0.00	.00	0.0	0.0	0.0	0.00	.00	0.0	0.0	0.0
	OCE/TI	35.28	.21	4.2	-22.8	-13.1	26.52	.20	-15.0	-29.1	11.6
	OCE/OCE	8.28	.15	-10.5	-17.6	5.8	2.04	.11	-14.1	-18.5	16.2
	NNCE/CE	20.12	.20	1.1	-43.2	-.9	8.24	.12	13.8	-44.4	2.0
	NNCE/NCE	8.64	.18	19.1	-48.9	-5.1	-1.04	.21	20.7	-38.0	-.5

* Estimates are obtained with the basic Model (Model A). Models B and C provide practically identical estimates. Because the models set means for the group TI/TI at zero, the table entries in effect show group means deviated from those for 'TI/TI' group. The abbreviations for variable names are: PRE = latent variable for pretest achievement; SCAF = socio-cultural advantage factor; HR = hours of regular instruction per year; HS = hours of special instruction per year; and HI = hours of tutor/independent work per year.

** TI/TI = Title I students in Title I schools; OCE/TI = other-CE students in Title I schools; OCE/OCE = other-CE students in other-CE schools; NNCE/CE = non-CE students in CE schools who are judged as needing CE; and NNCE/NCE = non-CE students in non-CE schools who are judged as needing CE.

The data show that the pretest performance of Title I students is generally comparable to that of the comparison non-CE students. However, other-CE students, particularly those attending Title I schools, on the average achieve at a slightly higher level than the other three groups. This is expected because most Title I services are directed to low-achieving students while the purposes of other CE programs are less clear. For the SCAF, the four groups of non-Title I students always have higher means than the Title I students, an indication that Title I programs indeed serve the most disadvantaged children.

The means for the service variables clearly show that, despite their judged need for CE, the comparison non-CE students receive considerably less special instruction but more regular instruction than the Title I students. Differences among groups of non-Title I students are less substantial. These data confirm the practice of providing special instruction primarily to CE students, particularly Title I students. Group differences in the amount of time spent working independently or with tutors are not as pronounced as those in regular and special instruction.

(2) *Within-Group and Pooled Effects of the Covariates*

Table 3-12 presents the within-group (as obtained with Model A) and pooled (as obtained with Model C) regression coefficients for the five covariates. In both reading and math, the data consistently show that pretest achievement is a prominent determinant for posttest achievement. In contrast, independent effects of amounts of instruction are found to be appreciable only sporadically. These effects frequently vary with groups, as indicated by the heterogeneous within-group coefficients for grades 1, 2, and 4 in reading and for grades 1, 3, 4, and 6 in math (see Test H_C in Table 3-9). The pooled effects are similar to those obtained with ordinary regression analyses (see Table 3-2) that employ the same background variables but only test scores for the recommended level.

Examining the data in Table 3-12, the effects of instructional services may be summarized for reading and math separately as follows:

- In reading, both the within and pooled coefficients for the service variables are mostly insubstantial for grades 2 through 4. Thus, the heterogeneous within-group regressions for grades 2 and 4 do not have practical implications and may be regarded simply as statistical artifacts. For grades 1, 5, and 6, appreciable independent effects of amount of regular instruction are noted consistently within the group of Title I students, but only occasionally within other groups. Because Title I students constitute a large group in the analyses, the pooled effects of regular instruction are also appreciable in these grades. The effects of amounts of special instruction and work with tutor or independently are generally negligible. The nonparallel within-group regressions in grade 1 largely reflect the lack of effects within the two groups of other-CE students.

- In math, amount of regular instruction consistently shows noticeable effects within the groups of Title I students in grades 2 through 5. In terms of the pooled effects, regular instruction demonstrates noticeable effects in all grades but grade 1. The data also show some appreciable effects of special instruction within the group of Title I students and for all groups combined in grades 4 and 5. In grade 1, where nonparallel regressions are evident, amount of special instruction has some small negative effects within the group of Title I students, but shows positive effects within the two groups of other-CE students. These differences among groups are reversed in grade 4, where the heterogeneity reflects that special instruction is helpful for Title I students but not for other-CE students. One possible explanation for such results might be the changes in curriculum to involve more complex concepts at grade 4. Effects of the amount of special instruction are seldom noticeable for the groups of comparison non-CE students, possibly because they don't receive much special instruction. The effects of tutor/independent work are found substantial primarily for the groups of comparison non-CE students in grades 4 and 6.

Table 3-12

Within-Group and Pooled Regression Coefficients in the ANCOVA Model With Latent Variables for Reading and Math Achievement of CE Students and Non-CE Students Judged as Needing CE†

Grade	Student Group†	Reading Analysis - Regression of Posttest Achievement on†					Math Analysis - Regression of Posttest Achievement on†				
		PRE	SCAF	HR	HS	HI	PRE	SCAF	HR	HS	HI
	TI/TI	1.374**	-14.56*	.041*	.018	.014	.948**	-3.84	.010	-.083*	.039
	OCE/TI	1.556**	-8.24	-.007	.004	.006	1.008**	2.56	.015	.224*	.221*
1	OCE/OCE	1.294**	-8.72	-.028	-.023	-.042	1.430**	-10.48	.259*	.438*	.213
	NNCE/CE	1.246**	-11.36	.028*	-.000	.002	1.024**	.08	.046	.002	-.014
	NNCE/NCE	.927**	24.80	.105**	.108*	.054	1.126**	20.72	.024	.019	.066
	Pooled	1.444**	-14.32*	.026*	.013	.013	.987**	1.84	.028	.004	.043
	TI/TI	1.248**	-4.80	-.013	-.010	-.030	1.144**	.48	.083*	-.018	-.054
	OCE/TI	1.119**	17.20*	-.018	.018	.052	.957**	28.72*	.075	.017	.037
2	OCE/OCE	1.337**	8.16	.020	.042	-.029	1.148**	23.68	.062	.022	.014
	NNCE/CE	1.246**	9.76	.058*	.014	-.005	1.063**	4.88	.039	.034	.002
	NNCE/NCE	1.123**	6.88	.037	-.066	.007	1.122**	6.08	.104*	-.034	-.020
	Pooled	1.196**	4.32	.012	-.001	-.014	1.067**	9.12*	.070**	-.002	-.014
	TI/TI	.821**	7.12*	.008	.006	.017	.932**	1.76	.066*	.022	-.009
	OCE/TI	.787**	9.76	.020	.016	-.004	.786**	4.92	.072	.018	.147*
3	OCE/OCE	.869**	1.60	.006	.006	-.012	.827**	8.72	-.026	-.134*	-.048
	NNCE/CE	.750**	8.64	-.006	-.002	.009	.777**	9.28	.058	.014	.026
	NNCE/NCE	.613**	27.04*	.018	-.024	-.066	.702**	12.32*	-.005	-.111	-.018
	Pooled	.805**	7.36*	.005	.004	.007	.810**	8.00*	.034*	-.016	.014
	TI/TI	.883**	9.60	.018	.022	.014	.925**	14.16	.067*	.191**	.029
	OCE/TI	.997**	12.16	.005	.022	.036	.804**	30.80*	.022	-.102*	.097
4	OCE/OCE	.964**	10.80	-.026	.043	.038	.863**	15.84	-.210*	-.038	-.063
	NNCE/CE	.896**	13.92*	-.007	-.019	.038	.897**	-2.40	.058	.117*	.141*
	NNCE/NCE	.893**	29.92	.099*	.018	-.040	.879**	15.36	.170*	.037	.143*
	Pooled	.945**	10.96*	.010	.016	.027*	.913**	10.48*	.065*	.090**	.067*
	TI/TI	.974**	6.16	.038*	.039*	.021	.903**	5.36	.075*	.078*	.017
	OCE/TI	1.007**	5.68	.049	.026	-.010	.873**	3.84	.027	.024	.046
5	OCE/OCE	.960**	1.68	-.040	.010	.035	.921**	5.60	-.033	.005	-.072
	NNCE/CE	.995**	6.88	.042*	.034	.009	.864**	.48	.041	.045	.042
	NNCE/NCE	.990**	8.24	.060	.002	.069	.843**	1.92	.042	-.077	.043
	Pooled	.997**	4.56	.032*	.032*	.014	.876**	3.12	.054*	.039*	.035
	TI/TI	.953**	1.44	.046*	.024	.056*	.995**	-13.44	.038	.022	-.062
	OCE/TI	1.000**	9.36	.025	.030	.036	.948**	11.68	.142*	.072	.115
6	OCE/OCE	.873**	1.52	-.036	-.078	.053	1.204**	7.60	-.110	.098	-.099
	NNCE/CE	.915**	9.52	.013	.015	.005	.883**	6.08	.045	.030	.099
	NNCE/NCE	.903**	39.52	.138*	.086	.116	.995**	13.52	.084	.037	.155*
	Pooled	.966**	4.40	.029*	.014	.029	.954**	4.80	.053*	.038	.073*

†Within group regressions are obtained with Model A; pooled regressions are obtained with Model C. Please refer to the text for descriptions of the models. The abbreviations for variables and student groups are explained in Table 3-11.

*z - ratio (estimate divided by standard error) exceeds 2.5.

**z - ratio (estimate divided by standard error) exceeds 5.0.

It should be noted that the results summarized above generally indicate only modest, although noticeable, effects of amounts of instruction on the achievement of disadvantaged students. These findings suggest that the differences in receipt of services between the CE and comparison non-CE students (see Table 3-11) are not likely to be the primary factors that lead to positive CE effects.

The socio-background factors (SCAF) show some noticeable effects on achievement growth, independent of pretest achievement and services. Positive effects are observed in grades 3 and 4 for both reading and math, and also in grade 2 for math. In contrast, the SCAF demonstrates some negative relationships with achievement growth in grade 1 for reading. This finding is similar to that in the previous path analysis and may be explained similarly by the different experiences in preschool learning among students from different backgrounds.

(3) Differences in Adjusted Group Means for Posttest Achievement.

The data in Table 3-9 indicate some moderate evidence for violation of the assumption of parallel regressions, particularly with respect to service variables, for grade 2 in reading and for grades 1 and 4 in math. (The other significances noted in that table are very marginal considering the large sample size in the analyses.) The preceding examination of the effects of instructional time suggests that the untenability of this assumption may have practical implications in the comparisons of adjusted group means only for grades 1 and 4 in math. Strictly speaking, only conditional comparisons of adjusted posttest means are appropriate in these two cases. In all other cases, comparisons of adjusted posttest means are not affected by the level of instructional services.

The intercepts estimated with Model B (which allows heterogeneous regression for the instructional variables) represent the conditional posttest means for the groups with amounts of instruction set equal to the means for Title I students. Therefore, comparison of these intercepts provides a basis for evaluating the effects of CE, conditional on instructional services. When the within-group regressions are parallel, comparisons in terms of the adjusted posttest means estimated with Model C are appropriate. However, in all of our analyses, the intercepts obtained with Models B and C show similar differences among the groups. We thus present only the adjusted means as obtained with Model C in Table 3-13, for the purpose of assessing the group (CE) effects. All adjusted means are expressed as deviations from the means for Title I students. For additional reference, the unadjusted means (estimated factor means for posttest achievement) are also presented in the table.

In reading, noticeable differences among groups are observed for grades 1 and 2. In both cases, Title I students exhibit the highest adjusted means. As the effects of instructional time have been controlled, these findings imply that some other CE-related variables must be responsible for the positive effects of Title I programs. For other grades, the differences are negligible, suggesting that after adjusting for differences in instructional time and background, there are no independent effects of CE.

Earlier, we found that positive pooled-effects of amounts of instruction on achievement growth were demonstrable only in grades 1, 5, and 6 for regular instruction and in grade 5 for special instruction. Considering the lesser amount of regular instruction received by CE students, Title I students in particular, in exchange for more special instruction, we conclude from these results that there is little evidence that the achievement growth of CE students is accelerated by way of the amounts and kinds of instruction they receive. The current analyses cannot support the contention that a reduction of the anticipated achievement gap between CE students and their non-disadvantaged peers will result from merely increasing the amount of special instruction. Thus, where there are observed benefits of CE to achievement of its participants, we need to continue the search for an explanation of how it works.

Turning to the results for math, the groups differ in adjusted means appreciably in all grades but grade 2. Again, Title I students always show the highest adjusted means. The results thus

Table 3-13

Group Differences in Unadjusted and Adjusted Means for the Latent Posttest Variable Assuming Homogeneous Regressions†

Grade	Mean	Reading Groups††					Math Groups††				
		TI/TI	OCE/TI	OCE/OCE	NNCE/CE	NNCE/NCE	TI/TI	OCE/TI	OCE/OCE	NNCE/CE	NNCE/NCE
1	Unadjusted	0.00	7.80	1.28	-8.28	-16.56	0.00	13.28	8.88	-15.84	-13.84
	Adjusted	0.00*	-6.12*	-5.00*	-2.12*	-5.20*	0.00*	-4.28*	-2.72*	-8.96*	-12.00*
2	Unadjusted	0.00	23.24	9.24	.96	-6.28	0.00	22.16	17.64	-5.96	-13.00
	Adjusted	0.00*	-6.80*	-.00*	-2.36*	-4.56*	0.00	-1.60	.00	-4.00	-4.24
3	Unadjusted	0.00	16.12	8.68	5.52	-2.92	0.00	9.96	5.84	-9.96	-9.80
	Adjusted	0.00	-2.12	-.28	-.92	-2.40	0.00*	-6.40*	-10.36*	-8.96*	-9.64*
4	Unadjusted	0.00	19.40	16.04	9.92	5.40	0.00	20.72	5.52	-3.08	-6.32
	Adjusted	0.00	-.52	-2.80	.08	.36	0.00*	-2.28*	-13.28*	-.76*	-4.40*
5	Unadjusted	0.00	18.40	15.44	13.08	-3.72	0.00	15.28	3.80	-1.20	-9.52
	Adjusted	0.00	-2.08	5.08	.56	.20	0.00*	-7.96*	-1.36*	-3.68*	-4.52*
6	Unadjusted	0.00	32.28	3.12	16.68	5.52	0.00	18.48	-5.48	-.92	-7.72
	Adjusted	0.00	-2.16	-5.08	-3.04	-3.44	0.00*	-6.72*	-7.80*	-8.56*	-7.40*

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† The adjusted means are based on the regressions of posttest on pretest, socio-cultural advantage factor, and amounts of instruction received in three settings (regular, special, tutor/independent), assuming homogeneous within-group regressions. Both the adjusted and unadjusted means are expressed as deviations from the corresponding means for the TI/TI group.

†† The analysis groups are: TI/TI = Title I students in Title I schools; OCE/TI = Other-CE students in Title I schools; OCE/OCE = Other-CE students in Other-CE schools; NNCE/CE = Non-CE students in CE schools who are judged as needing CE; NNCE/NCE = Non-CE students in Non-CE schools who are judged as needing CE.

* Differences in adjusted means among the five groups are significant at the .01 level.

provide some evidence that CE, specifically Title I programs, has positive effects on achievement growth, but the effects are independent of that of amounts of instruction. Except for Title I students in grades 4 and 5, special instruction does not show positive effects on achievement. By comparison, there is more evidence for positive effects of regular instruction. On the basis of these results, there is no reason for us to believe that the amounts and kinds of instruction received by CE students play dominant roles in explaining their achievement growth.

Conclusions from the ANCOVA. We now recapitulate the results of the ANCOVA with an emphasis on the role of instructional services in effecting the achievement growth of disadvantaged students. In both reading and math, CE students, specifically Title I participants, generally achieve at a comparable level at the pretest as that of the non-CE students judged to have need for CE. Title I students come from families with slightly more disadvantaged backgrounds than those of other CE students and comparison non-CE students. CE students tend to receive more special instruction but less regular instruction than needy non-CE students. The net differences in total instructional services indicate that Title I students receive more services than the other groups. However, judging from the scant evidence for positive effects of special instruction, the results do not support the expectation that provision of more intensive instruction to CE students will help reduce the achievement gap between them and the non-disadvantaged students. These remarks agree well with our conclusions based on ordinary regression analyses.

SUMMARY AND CONCLUSIONS

The effects of the amount of instruction received on achievement are studied with three approaches in order to understand how CE works. Assuming that the fan-spread hypothesis is valid, a simple treatment-effect correlational method is used to detect the effects of instruction. Overall, the negative correlations between achievement and amount of instruction received during the school year tend to decrease slightly from pretest to posttest, indicating a support for positive effects of total instructional time.

In order to determine the effects of different kinds of instruction, the total instruction is divided into amounts of regular instruction, special instruction (which characterizes the services received by CE students), and tutor/independent work. Multiple-regression and structural-relation models are then employed to determine the effects of these three kinds of instruction. For both reading and math, these analyses show that there are small but positive effects of regular instruction, while amount of special instruction seldom demonstrates noticeable, positive effects. Furthermore, only small proportions of the variation of posttest achievement are attributable to the combined effects of instructional time.

In the following, we briefly review some specific findings that are of interest to educators and policymakers.

- Controlling only for pretest differences, we find that slightly greater growth in achievement often results from increased amount of total instruction. Number of hours of instruction appears to be more sensitive to the relationship between instruction and achievement growth than the standard-resource-dollar index, which weighs different kinds of instruction according to the required labor-intensity.

- The amounts and patterns of services received by students are closely related to their achievement levels. Lower-achieving students receive greater amounts of services in patterns emphasizing instruction by special teaching staff and in small groups; while higher-achieving students receive lesser amounts with less emphasis on such special instruction. The practice of allocating services according to educational need can also be observed independent of student CE status. Generally, students from less advantaged backgrounds tend to have greater need and receive more instruction, especially the special instruction.

- The kind of instruction that most frequently shows positive effects on achievement growth, particularly in math, is regular instruction by classroom teachers in medium to large classes. Amount of special instruction which characterizes the services received by CE students, on the other hand, has mostly negligible, although often positive, effects on achievement. As a result, it is concluded that positive effects of CE cannot be explained by the kind of special instruction provided to the participants. Because such special instruction is often costly, the efficiency of service delivery in CE programs needs reexamination.

- In both reading and math, appreciable effects of the amount of regular instruction are more frequently noted within the group of Title I students than within other groups of CE or needy non-CE students. By comparison, amount of special instruction generally shows negligible effects, especially in reading, within the groups of CE and needy non-CE students.

- Even after adjustment for differences in amounts of instruction received, CE programs often show positive impacts on the achievement of their participants, Title I students in particular. Such effects of CE are probably attributable to program characteristics other than instructional time. The positive but modest impacts of compensatory programs are observed more frequently in math than in reading.

- The same model that relates the achievement process to student background, CE status, and receipt of instruction fits better for the math data than for reading. This suggests that reading achievement is a more complex process, possibly because there is a greater opportunity for learning to read outside the school; thus, reading achievement is influenced by a greater number of non-school factors.

- Selection for compensatory services is a primary factor for determining the pattern of instructional services received. CE students, particularly Title I students, receive substantially more instruction from special teaching staff and in small classes than non-CE students, but less from regular classroom teachers in large classes. However, the net difference shows that CE students generally receive more total hours of instruction. As amount of special instruction does not exhibit substantially positive effects on achievement, the positive effects frequently found in Title I programs must be attributed to other educational factors, possibly better quality of instruction.

- Posttest achievement is predominantly determined by pretest achievement, especially when achievement scores are corrected for measurement errors. Other background factors and instructional time have very modest, though sometimes statistically significant, independent effects on posttest achievement.

- In reading, children from disadvantaged homes achieve better progress at the first grade than their more advantaged peers. This result is found independent of student CE status. This phenomenon suggests that children from deprived backgrounds generally have little opportunity to learn primary reading skills prior to entering the first grade, but learn substantially as soon as they begin to receive formal instruction. In contrast, children from non-disadvantaged homes have already learned some of the skills before first grade and therefore do not necessarily learn new things from the same instruction. As a result, the disadvantaged children improve more during the first grade than other children. However, this initial 'benefit' from schooling for deprived children dissipates soon after the first year. In subsequent grades, the relationship between socio-cultural advantage and achievement growth returns to the normal expectation of greater growth for children from more advantaged homes.

- The same benefit of initial exposure to formal instruction for the disadvantaged children is not evident in math achievement. Pre-school learning in math is not as prevalent as in reading, and children from all backgrounds can almost equally benefit from initial math instruction. Again, as the skills become more complex in later grades, the socio-cultural advantage factor tends to show a positive relationship with learning in math.

Integrating the findings from these analyses, we conclude that amounts and kinds of instruction are not primarily responsible for the accelerated achievement of CE students. The positive effects of CE shown in our analyses probably reflect the effects of other educational practices. Exploratory analyses to study the effects of educational practices are discussed in part II of this report. Additionally, comprehensive analyses are planned in forthcoming reports using three-year data (Report 15), and in-depth observations of classroom processes (Report 16). Final judgments on the effects of CE and the roles of various educational experiences in achievement growth rest on these critical analyses.

Possible reasons for the disappointing conclusion of the present analyses are:

- The interval between pretest and posttest is too short to reveal any effects of instructional services if it requires a long-term effort to realize the benefits. This calls for investigations of the service effects on a continuous and long-term basis, as in later SES reports. The major drawback of a within-school year analysis is that any accumulated effects of services received in the previous years cannot be examined directly. Such effects are, in large part, absorbed into the pretest achievement. The inverse relationship between achievement and services at higher grades further undermines the possibility of revealing positive effects of amounts of instruction.

- The measures of instructional services fail to represent the amount of instruction directed to the material tested. This defect is more difficult to correct in a large-scale survey study. Further efforts in evaluating the effects of services may be more fruitful if they concentrate on in-depth observation of classroom instruction in small samples so that actual and relevant amounts of instruction can be recorded accurately.

  The use of in-depth observations in this study is illustrated in a later report on Successful Practices in High-Poverty Schools.

CHAPTER 4. CRITICAL LEVEL OF INSTRUCTIONAL EFFORT FOR IMPROVING THE ACHIEVEMENT GROWTH OF CE STUDENTS

This chapter concerns the question whether there exists a level of effort above which CE students will achieve larger gains than normally expected of them, and consequently show a narrowing of the anticipated achievement gap between them and regular students. Attempts were made to confirm the necessary condition for existence of such a threshold effort: a monotone and positive relationship between achievement growth and instructional effort. In most cases, the evidence is tenuous that such a relationship exists throughout the range of efforts commonly observed in the current programs. Lacking clear evidence for a strong and positive relation, we were unable to determine a critical level of effort that would effectively raise the achievement status of CE students.

Supplemental analyses were performed in order to provide more specific and detailed information on the achievement patterns of CE students in relation to the amount and intensity of services they received. Only in a few cases, the empirical data nearly substantiate the expectation of a monotonically increasing gain in achievement as the level of effort rises. Even in these cases, the positive relationships are not strong. In many other cases the data show a slight trend of larger gains for greater efforts in the middle range of efforts, but as the effort-level becomes very high, this trend is frequently reversed.

Based on the results of the present analyses, it was concluded that there was not enough evidence to support the concept of a 'critical level' of instructional effort for a meaningful reduction of the achievement gap suffered by CE students. Our chances of finding such a 'critical level', if it exists, may be improved by more refined measures of achievement growth and instructional effort and better analytic methods for studying their relationships.

In Chapter 2, the effects of CE on the achievement growth of its participants were assessed in terms of a variety of expectations (as estimated from norms, performances of appropriate comparison groups, and statistical models). The results provided the bases for evaluating the overall effects of CE at the national level. Clearly, the impacts of CE are of great importance for educational policy makers. But in order to obtain information that has relevance to making educational policies, we have to understand the educational factors that mediate the achievement growth. Only then can effective programs be designed and implemented for raising the achievement levels of disadvantaged students. To this end, we began, in Chapter 3, an effort to search for explanatory factors for achievement growth through a close examination of the role of instructional services. The effort will later be expanded to include examination of the effects of a host of educational-process variables in Part II of this report. In this and the next chapter, we will address still a few more issues concerning the delivery of instructional services.

Specifically, we are concerned with the existence of a critical level of instructional effort that is required for the anticipated achievement gap between the disadvantaged students and their non-disadvantaged peers to be reduced by a meaningful amount. This issue is of great interest because the answer can directly affect program emphases and policies for allocation of funds. The question is investigated first with a theoretical approach to determine if a critical level of effort indeed exists, and, if it does, what it is.

The concept of a critical level is closely tied to that of a 'critical mass' which has been addressed directly or indirectly in many evaluation studies. It is a very attractive concept because, if shown to exist, it would provide a basis for decisions on the distribution of CE funds and the amount of compensatory instruction to be offered. The key to success in finding such a critical level is the verification of the belief that achievement growth is a monotonically increasing function of the amount of effort (at least for a reasonable range of effort).

Recently, Dougherty and Klibanoff (1977) reviewed previous studies germane to this question and confirmed an earlier conclusion by Averch and his colleagues (Averch, Carroll, Donaldson, Kiesling, and Pincus, 1972) that there were no consistent relationships between resources (measures of effort) and effectiveness in raising achievement level. The analyses undertaken by Dougherty and Klibanoff reached a conclusion that there was little chance to demonstrate the existence of a critical mass. In the preceding two chapters, we found mixed results of CE effects and tenuous evidence for positive relationships between instructional services and achievement growth. These facts do not offer a very favorable prognosis for the present endeavor to find a critical level of effort. Nevertheless, the investigation of this issue was pursued because of its importance and because a different approach was employed. Not too surprisingly, the analyses again have produced little evidence for the existence of a critical level of effort. Even so, a brief discussion of the work is presented in this chapter in hope that we can offer some insight into improvements for future studies in this area.

We present several descriptive analyses of instructional services provided to students at different levels of effort, graphs of achievement gains against discrete levels of effort, and results of analyses of variance using a nested design, so that information may be extracted to shed light on the relationships between instructional effort and achievement growth. In particular, the aim of the ANOVAs is to help determine whether, at certain levels of effort, achievement gains of CE students may begin to surpass those of the comparison groups.

The supplemental analyses reveal that only in a few cases (e.g., in grades 4 and 6 for math), the average achievement gain for CE students consistently increases with increasing level of effort. However, even in such cases, the positive relationships are weak. Although in many other cases there is a small tendency for positive returns from increased effort at the intermediate levels of effort, this trend is frequently reversed by a decrease of gain at the extremely high level of effort. Analyses by student characteristics and for different kinds of CE programs did not clarify the picture appreciably. We think that improvement on the measures of achievement growth and instructional effort may be required for further progress in the inquiry on a critical level of effort.

IS THERE A CRITICAL LEVEL OF EFFORT FOR A REDUCTION IN THE ACHIEVEMENT DEFICIT OF CE STUDENTS?

To address this issue, we have to choose an index for the level of instructional effort. The educational services received by students are a compound of various inputs, such as instruction by teaching personnel with different qualifications, additional assistance from non-teaching personnel such as aides, and use of materials and equipment. But the consideration of the concept of a critical level necessarily implies acceptance of a unidimensional measure of effort. The alternative of looking for a specific combination of the component services that is needed to effect the desired achievement gain proves extremely difficult, because of the complex interrelationships among the components. The combination of services required for a specified amount of improvement (or level of achievement) is probably not a unique one under most models assumed for growth. If one imposes a production model that artificially leads to a unique combination of inputs for a specified output, the results will be mostly unverifiable with empirical data. For these reasons, we adopted a single index for the level of instructional effort.

The Measure of Level of Instructional Effort. Many previous studies dealing with the determination of a critical mass in compensatory education employed aggregated expenditure data at school or district levels. These expenditure data are distorted by price-level differences among districts or regions, and do not fairly represent the amount of resources used. Although some kind of adjustment (e.g., bv the local index of cost-of-living) is usually made, research based on these data has not been fruitful because they do not reflect direct resource-use in instruction for a specific subject area.

Occasionally, significant differences in effects on achievement were found among different expenditure levels, and the finding was interpreted as evidence for existence of a critical mass (e.g., Coulson et al., 1976). However, this type of finding usually cannot be replicated, even in different years of the same study (see Coulson et al., 1977).

To overcome the inadequacy of expenditure data for this kind of research, some studies have developed specific resource-cost models to convert resource-use into resource-costs. These models are designed primarily to discount the price-level distortions. At the same time, they also recognize the importance of separating the resource-costs for a particular subject from those for other subjects, and for outlays not directly related to instruction (for example, building maintenance). In the SES, a resource-cost model that incorporates only actual resources used in a subject into the calculation of costs has been developed to obtain standard-resource-dollar (SRD) costs for reading and math services. The resource-cost model was described in detail in Technical Report 6. The standard-resource-dollar costs (henceforth abbreviated as costs) were computed for each of the ten instructional items in the data-collection instruments, SPAR and SPAM (see Chapter 1), and then summed to yield a total resource-cost for each subject and each student. In each of the ten components of services, use of materials, use of equipment, and other clerical assistance are also included in the estimate of cost.

Because standard prices are applied to the resources used in all instructional programs, the total cost, in effect, is a weighted composite of the ten service items, with weights properly reflecting the labor-intensity of each item. The advantage of these differential weightings for the instructional items is that they provide a more sensitive distinction in receipt of services among students of different CE status than can be achieved by amount of time alone (see Reports 5 and 6). For policy relevance, the level of effort should take into account the intensity of labor, the largest single category of educational cost. For the present analyses, we therefore decided to employ this measure of total cost as an index of the level of instructional effort.

As this measure was also used in Technical Report 7 to study cost and effectiveness, it is important to note a slight difference between the cost model used in that report and the present one. In Report 7, teachers' years of experience and educational degree attained were disregarded in pricing the cost of a teacher's salary. In this report, we retain the differential prices according to a teacher's experience and education. This choice was made on grounds that the employment of teachers with different qualifications indeed reflects different amounts of effort in service delivery. An additional remark is that costs are computed on the basis of actual receipt of services in these two reports (i.e., they are adjusted by absences) rather than on the amount of services intended for the students. The readers are advised to keep these differences in mind when they compare the results discussed in different reports.

Search For a Critical Level of Effort. The first step in the determination of a critical level of effort is the investigation of the relationship of the measure of effort (total cost) to some index of achievement growth. In Chapter 2, different measures of growth were employed to examine the achievement patterns of CE and non-CE students in order to assess the effects of CE. These measures are again used for the present analyses. They include four kinds of gain scores:

- Z-score Gain. Posttest z-score minus pretest z-score, where z-score is the standard normal deviate corresponding to the percentile score. This index represents the expectation of maintaining the same relative achievement status from fall and spring.

- Residual Gain A. Residual posttest score obtained by subtracting the predicted posttest score from the observed posttest score. The predicted score was computed based on the regression model A, i.e., regression of posttest score on pretest score and student characteristics as estimated from data for non-CE students attending non-CE schools (see Appendix B5 for more explanation).

- Residual Gain B. Similar to Residual Gain A, but the Regression Model B, described in Appendix B5, replaced Model A. Regression Model B is a regression of posttest score on pretest score and student characteristics as estimated from data for non-CE students attending CE schools.

- VSS Gain. Posttest VSS score minus pretest VSS score.

For each of these four gain scores, the relationship of achievement gain of CE students with cost for services was examined by regression analysis. Because patterns of instructional services that place different emphases on various kinds of instruction may affect the relationships, we also performed the same regression analyses for each of six subgroups of CE students whose receipt of services conformed to the six instructional patterns explained in Chapter 3. In addition, both linear and curvilinear relations were considered (only the linear and quadratic models were fitted, as there was little evidence for higher-order relations). Thus, for each grade and for each subject (reading and math), 56 regressions (4 kinds of gain x 2 regression models x 7 analysis groups) were studied, resulting in a total of 672 regression equations. Few of these regressions supported the contention of monotonically increasing gains for increased costs. The division of CE students into six homogeneous subgroups of instructional patterns did not help us confirm the desired functional relationships between achievement growth and effort. Consequently, further discussion will be restricted to the analyses of the sample of all CE students. The results of the regression analyses for all CE students are summarized in Tables D-1 and D-2 of Appendix D, for the linear and quadratic models, respectively.

In the case of linear regressions showing positive relationships (see Table D-1), we go further to explore what amount of cost will produce a gain that brings the achievement level of CE students above the 'No CE' expectation for them. The rationale is that such a gain indicates that the anticipated (widening) gap between the CE students and their non-CE peers is arrested or is even narrowed. Similar investigations could be done for the quadratic case if there is a range of cost within which an increasing function of gain on cost is evident. However, the solution involves complicated iterative procedures and the regression analyses revealed no promising evidence for finding a reasonable critical level of cost. Therefore, we did not attempt such investigations for the quadratic case.

The method used to locate a critical level of effort where the functional relationship between gain and cost appears to be positive is outlined below:

1. The linear regression equation estimated in the analysis, in effect, provides the mean for the posterior predictive distribution of gains, given the observed data of costs and gains for CE students (see Box and Tiao, 1973; or Zellner, 1971). The scale parameter for this distribution (which incidently is a t distribution) can also be calculated. Therefore, one can compute the posterior predictive probability that a CE student receiving services of a given cost, C, will achieve a gain greater than some specified criterion. This probability becomes a reference for the determination of the critical level of effort.

2. A criterion of zero is chosen for the z-score gain, Residual Gain A and Residual Gain B, as the threshold that signifies some meaningful reduction of the achievement gap for CE students. This is a reasonable criterion because without CE intervention, we would expect the CE students to maintain their relative achievement status over time, or to progress like other non-CE students whose characteristics and ability are comparable to theirs. For the VSS Gain, two criteria are set, each anchored at the performance of one of the two comparison groups employed in Chapter 2. Explicitly, the average gains for the two groups of non-CE students judged to be in need of CE and attending CE and non-CE schools are considered as the expectations for CE students in the No-CE situation.

3. A probability of .9 is adopted as an indication of some certainty that a gain equal to or larger than the criterion will be achieved with the given cost. This strategy shares the same rationale expounded in the norm-referenced analyses presented in Chapter 2. Thus, if the probability

explained in 1, above, exceeds .9, there is evidence to suggest that a reduction of the anticipated achievement gap will be attained by services equivalent to the given level of effort. In this way, the critical level of effort is determined by finding a cost level that yields the required probability of .9 for each criterion. The original intent is to specify a range of costs that represents the critical level of effort for gap-reduction by combining the estimated critical costs for the five criteria. The cases where it was possible to obtain a reasonable estimate of the critical cost were noted in Table D-1. As seen in this table, our intent was not fulfilled, as a result of the frequent failures to find a required positive relationship between gain and cost (in some different ways, data in Report 7 point to these same failures).

Despite the unproductiveness of the analyses, they are discussed here so that future studies can benefit from our experience. The strategy we took for the determination of a critical level is a decision-based approach and could be useful for dealing with the problem of critical mass if the data can substantiate the expected positive and increasing return from increased instructional efforts. We cannot assess to what extent the index for effort itself is responsible for our inability to find positive relationships. The disproportionally high cost for special instruction that tends to show negative relations to achievement growth (see Chapters 6 to 8) is likely to be one of the major causes for the disappointing results. However, substitution of the total number of hours of instruction for the total cost would probably not eliminate the problems, because the latter measure also suffers from lack of positive relationships with achievement growth. Besides, it does not include effort not directly recorded in the SPAR and SPAM (i.e., the use of material and additional personnel). Conceptually, the total cost is a better reflection of the intensity of effort than the amount of time. At this point, we are forced to conclude that there is little evidence to support the existence of a critical level of effort.

ADDITIONAL ANALYSES RELATING EFFORT TO ACHIEVEMENT GROWTH

As we have made a serious attempt to find analytical solutions to the problem of critical level of instructional effort, but without avail, we now turn to a discussion of descriptive analyses in yet another attempt to uncover some relevant information from the wealth of our data. The remainder of this chapter therefore focuses on analyses of variance employing a design with nested factors in order to assess differences in achievement gains among CE students who received services at different levels of cost (effort), and to compare their achievement gains with those of the non-CE students who were judged as needing CE but did not receive it.

In addition, average achievement gains for CE students and the comparison groups are graphed against levels of cost for the services they received in order to allow a visual inspection of the relationship. Supplemental data describing the numbers of hours of instruction received in different settings and the associated resource costs for the CE students and the comparison groups are provided in Appendix D. Finally, the relationships between instructional effort and achievement growth are examined for subgroups of students with different backgrounds in order to study the influence of student characteristics on such relationships.

Descriptive Analyses of Services Received and Achievement Growth

To aid us in understanding the relationships between instructional effort and achievement growth, we examined the profiles of services received and the patterns of achievement growth at different levels of effort (cost). In each grade, eight levels of cost were defined in terms of distances in half standard-deviation units below and above the mean for the distribution of total service costs in standard-resource-dollars over all CE students. Table D-3 of Appendix D presents the means and standard deviations (s.d.) upon which the levels were based. Costs that are less than or equal to 1.5 s.d. below the mean comprise the lowest cost level and costs that are greater than 1.5 s.d. above the mean comprise the highest. The eight levels were obtained for reading and math services separately. Parallel analyses were performed for the two subjects employing respective cost levels and data for services and achievement.

We first described the profiles of services received in ten instructional arrangements (as listed in SPAR and SPAM) by CE students at each of the eight levels of effort. Then graphs of average achievement growth as a function of the level of cost were made in terms of each of the four kinds of gain scores explained in the preceding section. The purpose of these analyses is to display the data in convenient ways that can be studied to arrive at a better understanding of the complex relationships between achievement growth and receipt of services.

The second set of analyses compares receipt of services and achievement gains among five groups of students at given cost levels. The five groups comprise the three categories of CE students (Title I students, Other-CE students in Title I schools, and CE students in Other-CE schools), and the two comparison groups of non-CE students (students judged as needing CE but attending non-CE schools, and non-CE students judged as needing CE and attending CE schools). In Chapter 2, we found some overall differences in achievement gains among these five groups, and in Chapter 3, we examined the role of amounts of time spent in three different instructional settings (regular, special, and tutor/independent work) in explaining the differences. We now examine the differences in achievement growth among the groups in the context of costs for services they received. For each group, we describe the service profiles by cost levels and prepare graphs of achievement growth against cost levels. The addition of the CE/comparison group factor to the descriptive analyses necessarily increases the volume of data to be compiled. For ease of presentation, we replaced the ten instructional components with the three service composites employed in Chapter 3, and reduced the cost levels from eight to four by expanding the intervals to 1 s.d. (instead of the earlier half s.d.). The three composites of services would still afford us clear comparisons among the groups because each composite is formed on the basis of its ability to differentiate between CE and non-CE students.

At each fixed level of effort, we compare receipt of services between CE and non-CE students because even if they receive services at comparable costs, the patterns of services they receive may still differ and affect their learning differentially. If there is little difference in cost as well as in pattern of service delivery among the groups, then any differences in achievement growth among them are unlikely to be explainable by the service factor. In this case, we have to look for other factors to explain achievement differences.

Services Received by CE Students and Their Achievement Growth, by Level of Effort. In Tables D-4 and D-5 of Appendix D we tabulate average hours and costs of services received in the ten instructional components for each of the eight cost levels of reading instruction. Tables D-6 and D-7 provide parallel data for math. Examining the proportional allocation of the total services to the ten components, we find that emphasis of instruction in small groups (1-6 students) and by special teachers increases with increasing levels of cost. At the highest cost level, these kinds of reading instruction account for more than 50 percent of the total service costs as well as total instructional time for CE students. In math, they account for more than 40 percent of services at the highest level of cost. Comparisons of the corresponding proportions for time and cost make explicit the prominent determinants of service costs. Specifically, high costs are overwhelmingly associated with small instructional groups and, to a lesser extent, with employment of special teachers. The data in these tables also show that differences in receipt of services among CE students across the cost levels are primarily observed in these kinds of special instruction, as are differences between CE and non-CE students (see Report 5).

With increasing levels of cost, classroom instruction and independent work account for decreasing proportions of services received. Comparisons across grade levels reveal that the average use of aides declines with increasing grade, whereas large classroom instruction increases (at least through the sixth grade). In terms of the average total services across cost levels, we see that in reading the amount of services decreases with increasing grade level. This conforms to the notion that since reading skills are necessary for much of school learning they must be emphasized in the early years. In math, on the other hand, we see that the average number of total service hours (thus, the curricular emphasis) remains about the same from year to year though slightly more effort is expended in grades 3 through 5 where complex and novel concepts are introduced.

The relationships between the achievement growth of CE students and the level of costs for the services they received are illustrated in Figure 4-1, with VSS gains as the measure of growth. There, the average gains for CE students are plotted at eight levels of cost. Similar data using Z-Score Gain, Residual Gain A, and Residual Gain B (see earlier descriptions) as the indexes of growth are presented in Appendix D, Figure D-1 for reading and D-2 for math.

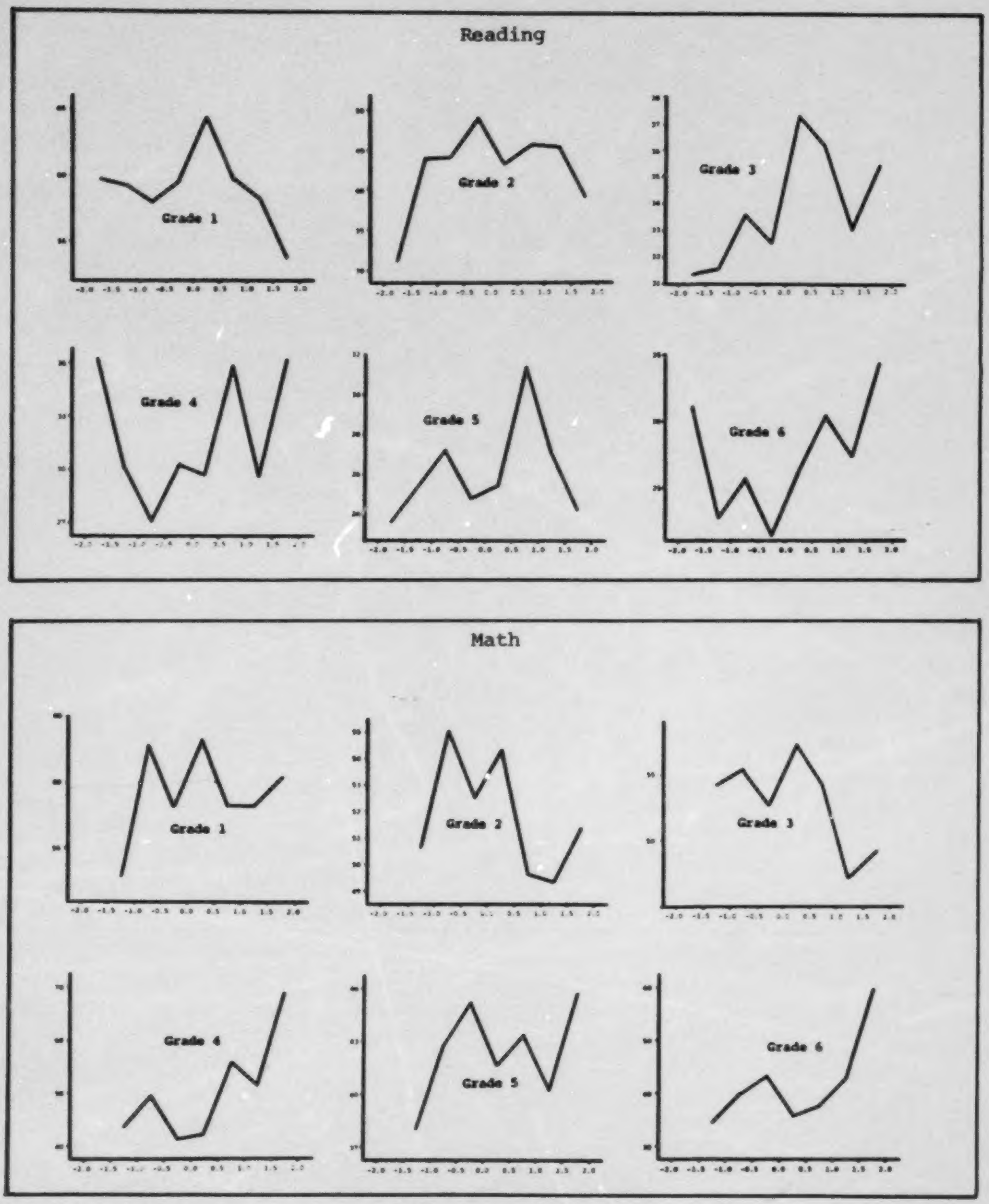
Examining the graphs in Figure 4-1, we can discern a nearly consistent pattern of increasing gains with increasing cost levels only in grades 4 and 6 for math. Additionally, slightly positive trends may be seen in grades 3, 5, and 6 for reading, and in grades 1 and 5 for math. However, in these instances, the curves fluctuate so much that no clear relationships between level of effort and achievement growth can be inferred with confidence. In most cases, the patterns of gains vary with the ranges of cost and periodically show decreasing trends as cost levels rise. The decreasing trends are especially noticeable in grades 1, 2, 3, and 5 for reading and in grades 2 and 3 for math when costs are at the two highest levels, although the importance of these findings may be undermined by the small sample sizes for these data points.

Comparison of the curves in Figure 4-1 with the corresponding ones in Appendix D reveals that the findings are generally similar when different indexes of growth are employed. But, there are occasionally marked differences. In particular, in grade 3 for math, the picture for z-score gain shows striking departure from the other three graphs for different indexes of growth. On the whole, the relationships between level of instructional effort and achievement growth are not consistently positive, and are not affected by the index of growth.

The irregularities of the curves in these figures vividly demonstrate the difficulties for fitting smooth functions with a positive trend to the data. Among the probable reasons for these irregularities are the low reliabilities of gain scores, the allotment of services in accordance with needs, and the influence of outliers. It is possible that development of better indexes for growth, careful scrutiny of unruly outliers, and use of robust regression procedures (Hogg, 1974) could improve the situation. However, we are not optimistic in this regard, considering the frequent and disorderly fluctuations of the curves. Until we can confirm the positive ties between achievement growth and instructional effort, the search for a critical level of effort cannot be fruitful.

In summary, CE students receive increasingly more instruction in small groups and from special teaching staff as the cost level for the service increases. But the increase in amount and intensity of instruction does not always result in greater achievement growth. The lack of a systematic and positive relationship between achievement growth and instructional effort largely explains the failure in our theoretical approach to locating a critical level of effort for narrowing the anticipated achievement gap between CE students and their non-deprived peers.

Comparison of Services Received Between CE and Needy Non-CE Students. The average costs of reading and math services are presented in Table 4-1 for three groups of CE students and two comparison groups of non-CE students who were judged as needing CE. As shown in this table, Title I students on the average received services at the highest cost among the five groups. This observation applies to most grades and to both reading and math. The few exceptions were found in the first two grades where CE students in Other-CE schools sometimes received services at higher cost than that for Title I students. It is also clear that the two comparison groups of non-CE students generally received services of considerably lower cost than any CE group (with rare exceptions in the first two grades for math). Indeed, the earlier finding (see Chapter 2) of greater progress for Title I students is accompanied by higher costs for services they received. However, as also observed in Report 7, the substantial increases in service costs for Title I students (reaching an amount of more than 50 percent above the costs for the comparison groups in the upper grades) render the increased gains, when found, insufficient to demonstrate the cost-effectiveness of CE.



Note. — Numbers of cases on which means are based can be found in Table D-4 for reading and Table D-6 for math.

Figure 4-1

Average Fall-to-Spring VSS Gains (Vertical Axis) in Reading and Math for CE Students, by Levels of Service Costs (Horizontal Axis, Indexed by Number of Standard Deviations Away From the Mean Costs for All Students in the Subject)

Table 4-1

Mean Total Standard-Resource-Dollar Costs for Reading and Math Services Received in 1976-77 for Three Groups of CE Students and Two Comparison Groups of Non-CE Students Judged as Needing CE*

Grade		CE Status				
		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Needy Students in Non-CE Schools	Needy Non-CE Students in CE Schools
Costs for Reading Services Received						
1	N	1,556	519	339	304	1,240
	Mean	428.7	390.7	447.8	339.5	364.1
2	N	1,805	583	426	320	950
	Mean	428.4	376.1	443.5	297.8	346.5
3	N	1,702	478	412	323	902
	Mean	392.3	344.4	391.7	305.2	317.0
4	N	1,318	410	402	340	1,046
	Mean	384.4	335.8	322.2	226.2	258.6
5	N	1,225	394	385	266	1,187
	Mean	333.8	282.2	312.6	219.8	223.5
6	N	1,126	539	351	351	1,367
	Mean	336.9	228.5	280.5	207.8	207.3
Costs for Math Services Received						
1	N	772	426	210	591	966
	Mean	203.0	142.5	197.2	144.3	150.8
2	N	902	477	165	555	762
	Mean	198.8	149.1	205.6	135.0	184.9
3	N	920	385	250	615	818
	Mean	228.4	187.4	196.7	150.5	161.8
4	N	710	394	255	671	821
	Mean	255.0	277.3	210.7	149.1	174.3
5	N	716	350	246	723	936
	Mean	260.0	203.8	204.2	158.8	160.6
6	N	642	549	246	739	1,061
	Mean	241.3	172.3	189.9	176.3	141.7

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*Only cases having complete data in CTBS fall and spring scores, student background characteristics, hours and costs of services received, and CE status were included in the present analyses.

When we consider the initial achievement status for the five groups, the differences in receipt of services among them become easier to understand. Referring to Tables E-1 and E-2 in Appendix E, it may be seen that in both reading and math, Title I students tend to have the lowest pretest scores at all grades. The receipt of services at the highest cost by Title I students in grades 3 through 6 suggests that there is a tendency to allocate services based on educational need. On the other hand, in grades 1 and 2 for reading and in grade 2 for math, CE students in Other-CE schools received services at higher cost than Title I students in spite of the lower achievement status of Title I students. This finding runs counter to our expectation of more intensive services for lower achievers, and may be an indication that Other-CE schools tend to concentrate services of high labor-intensity on the early grades. Comparing the two groups of needy non-CE students, those attending non-CE schools received services at lower costs. As needy non-CE students in non-CE schools also achieved lower average pretest scores, this result led us to suspect that there might be some kind of additional remedial effort in CE schools, or there might be some spillover of CE services to the non-CE students who were judged to have need for CE. The unintended benefit to the needy non-CE students in CE schools could result from the schools' general efforts to upgrade services for their students.

The comparisons of services received by different groups of students are also made at various levels of cost. In Tables D-8 and D-9 of Appendix D, average hours and costs for reading services received in three kinds of instructional settings are tabulated by four levels of total resource-cost, for each of the five CE and non-CE comparison groups. Tables D-10 and D-11 in the same Appendix present parallel data for math. It is important to note in these tables that students in the five groups are not distributed in the same way across levels of cost. In math, the distribution is skewed for Title I students in that a greater proportion of them received services at high costs than at low costs. This characteristic is much less pronounced in reading where the distribution of Title I students is almost symmetrical about the average cost for all CE students. In both reading and math, services at costs that are below the average for all CE students are typical for Other-CE students in Title I schools. The pattern of costs for reading and math services received by CE students in Other-CE schools changes with grades, such that in the first two grades the distribution is approximately symmetrical; however, in the upper grades, services at costs that are lower than the average for all CE students are provided to them more frequently. As expected, the majority of the non-CE students in the two comparison groups received services at costs lower than the average for all CE students. However, there were still many students in these comparison groups who received services at considerably high cost.

Inspection of the four tables (D-8 to D-11) for comparisons among groups with respect to mean hours of services reveals similar patterns across cost levels. That is, as emphasis on special instruction increases, cost for services increases. Within a cost level, the allocation of services to the three kinds of instruction differs little among groups except at the lowest cost level. At the highest cost level, more than half of the time for reading services is spent in special instruction. For math, the proportion of time allocated to special instruction at the highest cost level sometimes drops slightly below 50 percent but mostly stays above it across all groups and all grades. By contrast, at the lowest cost level, the profile of instruction for CE students resembles that projected for the SES population (see Table C1-1 in Appendix C1); about 16 to 21 percent of the time for reading services and about 10 to 15 percent for math are spent in special instruction. However, for the two non-CE comparison groups, the proportion allocated to special instruction at this low level of costs falls noticeably short of the population value. The upshot of this discussion is that differences in services received between the CE and needy non-CE students exist not only in terms of total resource-costs, but may also be in terms of the ways in which the efforts are allocated.

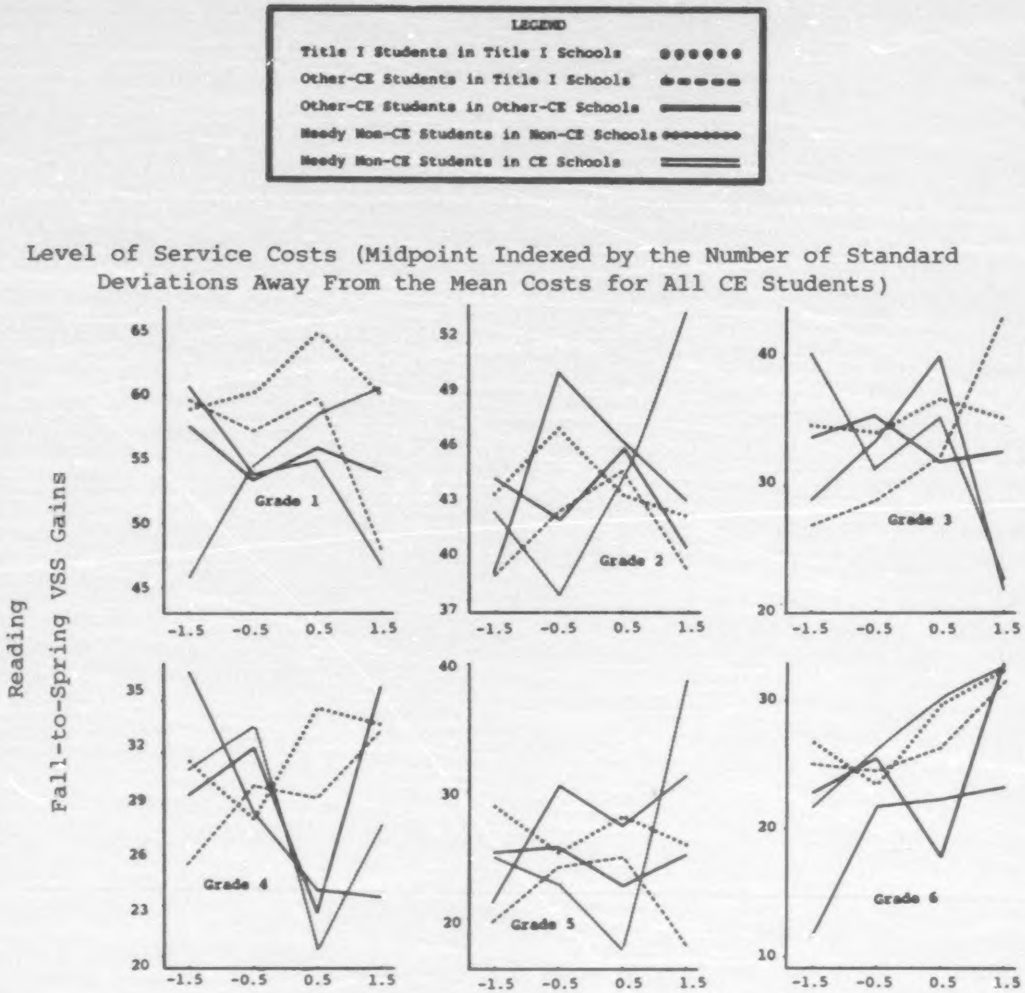
Relationship Between Achievement Growth and Receipt of Services for Different Groups of CE and Needy Non-CE Students. Because the educational programs for CE and Non-CE students are, in theory, different, we are concerned that the relationships between achievement growth and instructional effort may differ among the five groups of students. Even at comparable levels of effort and with similar allocation of instructional time, the students in different programs may experience different educational practices in other aspects. To address this concern, we examined the relationships between growth and effort for different groups of students separately. For this purpose, the average VSS gain is plotted as a function of cost level, for each of the five groups, in Figure 4-2 for reading and in Figure 4-3 for math. Similar graphs are also prepared using the other three indexes of growth (z-score gain and two kinds of residual gain scores), and presented in Figures D-3 through D-5 of Appendix D.

The graphs in Figures 4-2 and 4-3 again demonstrate, as in Figure 4-1, that few of the relationships between growth and effort are monotonically increasing. Clearly, small sample sizes for several of the data points (particularly at the lowest and the highest cost levels) may result in unstable estimates of mean growths and inaccurate reflections of their relationships with efforts. But the departures from monotonicity are frequently too noticeable to be attributed entirely to such errors. Although the relationships appear to differ among groups, there are no clear patterns for the differences. Within each group, the relationships are generally similar for the four different indexes of growth; erratic fluctuations of average growth across cost levels are common regardless of which index is employed.

An advantage of displaying the curves for different groups in a same graph is that it facilitates the comparisons of achievement growth among the groups at specific levels of effort. Examining the graphs, we find that, *at the same cost-level,* CE students often do not achieve greater gains than needy non-CE students. Title I students consistently exhibit greater gains than needy non-CE groups only in grade 1 for reading and in grades 3 and 4 for math. The result showing infrequent cases of systematically larger gains for CE students at fixed cost level comes as no surprise to us. So far we have been able to show only that proportionally more CE students received services at higher cost than non-CE students whose teachers considered them having need for CE. However, for a given level of effort, there has been little evidence of differences among the groups with respect to time allocations (the only exception being when level of effort is low). Furthermore, it was found in Technical Report 5 that there were no appreciable differences in exposure to a variety of educational practices between CE and non-CE students. These findings suggest that CE and non-CE students are not likely to learn differently if they are comparable in educational disadvantage and receive comparable services.

In light of these results, we conclude that there is no convincing evidence for a systematic and positive return from increased effort in instruction, even when the relationships are examined separately for homogeneous groups of students who were exposed to similar programs. In general, the relationships between achievement growth and level of effort are inconsistent across the groups and the grades. The graphic displays of the data clearly indicate that services associated with higher cost do not necessarily result in greater growth. This lack of positive relationships is common for the three groups of CE students as well as for the educationally needy non-CE students. These findings suggest that analysis for separate groups of CE students by funding sources of their programs would not improve the chance to find a 'critical level of instructional effort' for the reduction of their expected achievement deficits.

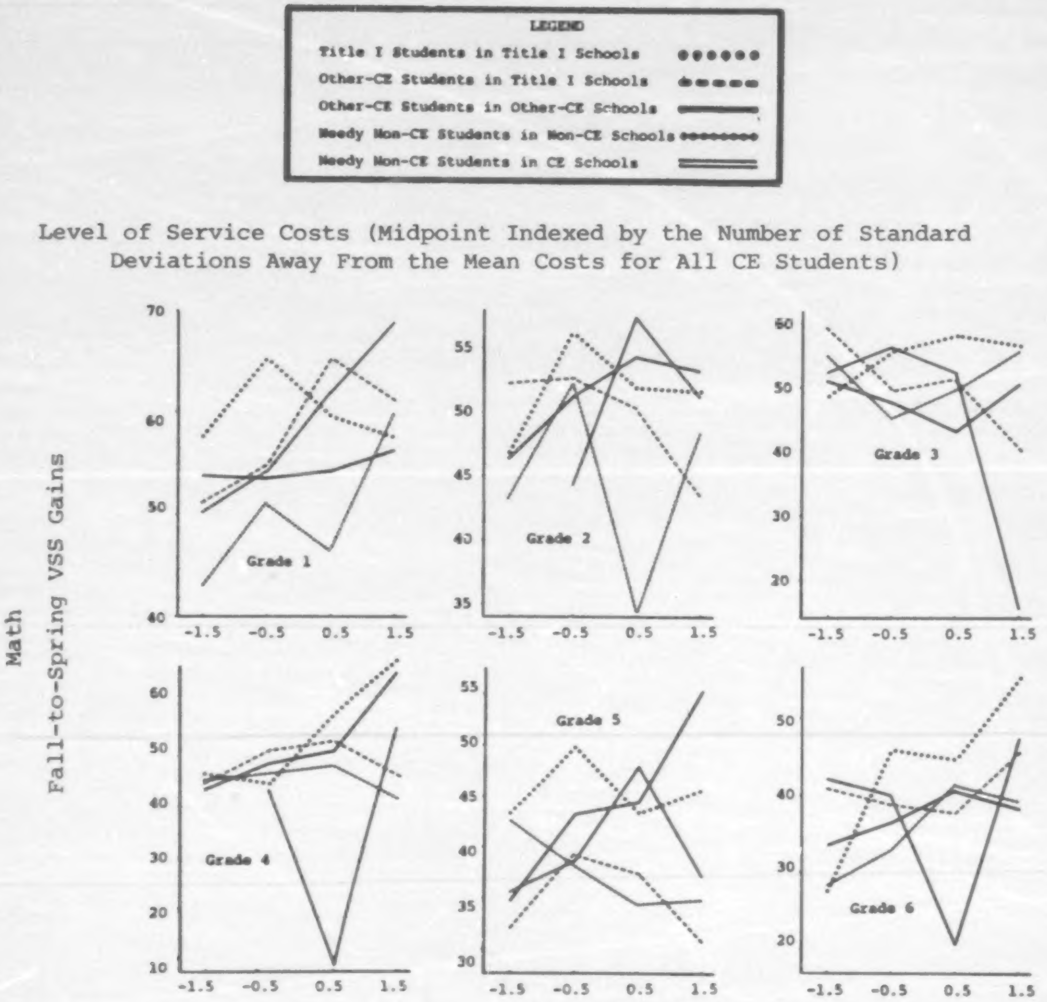
Conclusion From the Descriptive Analysis. The analysis of services received by CE students and their achievement patterns at different levels of effort reveals that, as intended, CE programs have provided services associated with high cost to more educationally deprived students than regular programs; but services at high cost do not clearly produce a positive return in achievement gains. Services at high cost are typically characterized by emphasis on small-group instruction and, to a lesser extent, on employment of special teaching staff. Our results suggest that other catalysts for educational progress would be required in order to overcome the educational disadvantage of CE students. However, as will become clear in Part II of this report, we are still a long way from being able to determine exactly what elements of the educational processes constitute effective remedies for deficiency.



Note. — Numbers of cases on which means are based can be found in Table D-8. Means based on fewer than 5 cases are not plotted.

Figure 4-2

Average Fall-to-Spring VSS Gains (Vertical Axis) in Reading for the Three Groups of CE Students and Two Groups of Non-CE Students Judged as Needing CE, by Levels of Service Cost (Horizontal Axis)



Note. — Numbers of cases on which means are based can be found in Table D-10. Means based on fewer than 5 cases are not plotted.

Figure 4-3

Average Fall-to-Spring VSS Gains (Vertical Axis) in Math for the Three Groups of CE Students and Two Groups of Non-CE Students Judged as Needing CE, by Level of Service Cost (Horizontal Axis)

Examining the Effects of CE by Level of Instructional Effort

In order to study the effects of CE in relation to instructional effort, an analysis of variance design was adopted in which CE students were divided into subgroups by levels of standard-resource-dollar cost and funding sources for the services they received, whereas the two non-CE comparison groups were included as intact groups. In other words, this program (treatment) factor consists of three groups of students: CE students, needy non-CE students in non-CE schools, and needy non-CE students in CE schools. Nested within the CE group are three categories of CE students (Title I students, Other-CE students in Title I schools, and CE students in Other-CE schools), each of them is further subdivided into four levels of cost for services. The complete layout of this design is explained in Tables D-12 and D-13 of Appendix D. These analyses compare the achievement gains for CE students receiving services at different costs with the overall gains for the two non-CE comparison groups, which serve as estimates of expected gains in the 'No-CE' situation. These comparisons were aimed to determine at which levels of effort a particular group of CE students would achieve better than the 'No-CE' expectations. The analyses were performed for reading and math separately, and for the four different indexes of growth (VSS gain, z-score gain, and two kinds of residual gains).

Tables D-12 and D-13 also present the mean gain and sample size for each cell in the design, for reading and math, respectively. In addition, significance tests for five effects are included: unadjusted treatment effects; main effects of the treatment factor, CE category, and cost level adjusted for each other and interactions; and the interaction effects between CE category and cost level adjusted for their main effects. Our principal interest is to examine the influence of cost level on the effects of CE.

Results of the Analysis of Variance for Reading. The overall relationships between level of effort and achievement growth are insignificant at the .01 level in all grades with rare exceptions. But, in grade 3, the interaction between CE category and cost level shows significance for three of the four measures of gain. In this grade, whereas there is no apparent cost-level effect for Title I students, the effect of cost level for other-CE students is such that considerably higher gains are obtained at the highest cost level for those in Title I schools, and at the next-to-highest level for those in other-CE schools. In either case, the average gain exceeds the averages for both groups of non-CE students. However, there is no clear explanation for this finding in a single grade.

The adjusted main effects of CE category are consistently significant (at the .01 level) in grades 1 and 6, regardless of which index of growth is used. In the top section of Table 4-2, we present the marginal mean gains for each of the three subgroups of CE students in these two grades, along with the means for the two groups of needy non-CE students. As shown there, Title I students achieved the highest average gains among the CE subgroups, exceeding those for both groups of needy non-CE students. Although not presented in the table, the least-square estimates of these means that have been adjusted for the unbalanced sample sizes confirm the same finding.

As Title I students tend to achieve lower pretest scores than other-CE students, we suspect that regression artifacts may affect these mean differences. The top section of Table 4-3 gives the average percentile scores at pretest for the same five groups of students, by cost level.

Indeed, Title I students tend to have the lowest pretest scores among the CE students; but their scores are generally similar to those for the needy non-CE students. Within each CE group, pretest achievement status tends to be inversely related to cost level. These data suggest that the regression phenomenon may affect our findings. However, it is important to remark that the average gains for the groups do not exhibit the reversed rank-orders of their pretest scores. This observation and the sizeable differences in means support our contention that there is evidence for greater effects of CE for Title I students than for Other-CE students.

Table 4-2

Mean Achievement Growth for the Three Groups of CE Students and the Two Comparison Groups of Non-CE Students Judged To Be in Need of CE, for Grades 1 and 6 in Reading and for Grades 3 and 4 in Math

Grade	Index of Achiement Growth*	CE Categories				
		Title I Students in Title I Schools	Other-CE Students in Title I Schools	Other-CE Students in Other-CE Schools	Needy Non-CE Students in Non-CE Schools	Needy Non-CE Students in CE Schools
Reading Achievement						
1	Z-Score Gain	0.05	-0.12	-0.18	-0.07	-0.07
	Residual Gain A	6.78	-2.76	-5.06	0.43	3.84
	Residual Gain B	4.22	-4.19	-5.46	-2.75	0.30
	VSS Gain	61.38	56.88	53.46	53.50	54.92
6	Z-Score Gain	0.05	0.01	-0.05	0.01	-0.00
	Residual Gain A	-3.33	-2.03	-10.82	-6.21	-5.94
	Residual Gain B	6.57	1.85	-0.81	2.97	2.96
	VSS Gain	27.67	25.57	20.74	24.98	24.28
Math Achievement						
3	Z-Score Gain	0.13	0.01	-0.09	-0.05	-0.04
	Residual Gain A	15.40	-2.72	1.44	-0.07	2.60
	Residual Gain B	-1.40	-8.55	-10.35	-7.77	-7.83
	VSS Gain	55.98	51.27	49.75	50.59	48.86
4	Z-Score Gain	0.07	-0.01	-0.21	-0.02	0.00
	Residual Gain A	1.28	-0.32	-13.86	-1.38	1.14
	Residual Gain B	-5.04	-2.51	-18.51	-11.33	-9.14
	VSS Gain	52.20	50.23	34.58	46.45	48.55

*Two kinds of residual gain were obtained as observed minus predicted posttest score. For residual gain A, a regression equation estimated with data from non-CE students attending schools that do not provide CE in the subject area was employed to compute the predicted posttest score. For residual gain B, the regression equation was estimated with data from non-CE students attending schools that provide CE in the subject area. For descriptions of the regression models used, see Appendix B5.

Table 4-3

Average Pretest Percentile Ranks for the Three Groups of CE Students and the Two Groups of Non-CE Students Judged To Be in Need of CE, by Cost Level of Services Received for Grades 1 and 6 in Reading and for Grades 3 and 4 in Math

		CE Categories				
Grade	Cost Level*	Title I Students in Title I Schools	Other-CE Students in Title I Schools	Other-CE Students in Other-CE Schools	Needy Non-CE Students in Non-CE Schools	Needy Non-CE Students in CE Schools
Reading Achievement						
1	Low	34.6	45.5	31.0	20.2	30.8
	Low Average	31.9	46.6	42.0	30.5	28.5
	High Average	31.8	37.8	41.4	25.8	31.9
	High	28.7	31.9	35.6	24.1	31.0
	Total	31.7	42.8	40.0	26.4	29.9
6	Low	31.3	45.4	34.5	27.1	31.3
	Low Average	20.7	37.6	24.2	23.2	28.4
	High Average	17.6	25.0	19.4	15.5	25.7
	High	18.5	15.8	19.5	11.3	21.9
	Total	20.0	36.1	23.7	23.4	28.8
Math Achievement						
3	Low	27.8	39.0	29.7	26.9	26.4
	Low Average	28.3	45.2	40.1	25.0	27.3
	High Average	25.7	29.7	29.5	25.4	28.9
	High	26.1	24.9	34.7	24.6	25.2
	Total	27.1	39.1	36.6	25.8	27.1
4	Low	37.0	48.9	60.0	24.3	28.5
	Low Average	25.9	42.7	39.5	26.3	27.8
	High Average	25.1	37.2	34.4	21.0	24.0
	High	22.0	25.3	17.4	22.6	18.5
	Total	26.0	40.1	37.1	25.6	26.9

*The four cost levels for reading/math are defined in terms of the mean and standard deviation (s.d.) of the total resource cost of services for all CE students within each grade as follows: Low = one or more s.d. below the mean; Low Average = zero to one s.d. below the mean; High Average = zero to one s.d. above the mean; High = one or more s.d. above the mean. The lower end point of each level is excluded from that level.

Further examination of the cell means in Table D-12 discloses that the positive effects of CE for Title I students in grades 1 and 6 become evident at the two high cost levels, which represent services at cost higher than the average for all CE students. The positive payoff for high-cost services, however, may not be large enough to be cost-effective (see Report 7).

Additionally, both unadjusted and adjusted main-effects for the treatment factor (CE vs. Non-CE) are significant in grades 3 and 5, when the two residual gain scores are analyzed. In grade 3, the direction of difference is in favor of the needy non-CE students in CE schools. In grade 5, when residual gains are obtained based on data for non-CE students in non-CE schools, average gains are higher for CE students, regardless of cost levels, than for either group of non-CE students. The only exceptions are found at the lowest and highest cost levels for other-CE students in Title I schools. Elsewhere, occasional significances are obtained without consistency over measures of gain or grades. Such scattered significances generally do not lend themselves to clear interpretations and are likely to be the result of chance.

Results of the Analysis of Variance for Math. More interaction effects between cost level and CE category are significant in math than in reading. These findings are consistent across measures of gain in grades 3 and 4. In addition, the adjusted main-effects for CE category and for cost level are also consistently significant in these two grades. To aid us in interpreting these results, marginal mean gains and average pretest percentile scores by cost levels are presented in the bottom sections of Tables 4-2 and 4-3 respectively, for the three groups of CE students as well as the two non-CE comparison groups. The data in Table 4-3 again show a systematic inverse relationship between pretest achievement status and cost level in grade 4 for all groups. Such an inverse relationship also holds in grade 3 but with occasional violations. Among the CE students, Title I students tend to have the lowest initial achievement status which is comparable to that for the two groups of needy non-CE students. The initial achievement status for other-CE students is considerably higher than for the other groups.

Examining the marginal means in Table 4-2, we find that Title I students usually attained larger gains than did other groups. In all cases, mean gains for Title I students exceed those for either group of needy non-CE students. Again, data in Tables 4-2 and 4-3 suggest that regression artifacts do not account for much of the differences in gains among the groups. With respect to levels of cost, the only marked effects are observed at the two higher-than-average cost levels for Title I students where their gains clearly and consistently exceed the gains for all other groups (subgroups of other-CE students at any cost level and the two groups of needy non-CE students). Thus, the results point to a positive return from services at increased cost, specifically for Title I students in these two grades. The least-square estimates of means support the same findings.

In both grades 3 and 4, the interaction effects between CE category and cost level largely reflect the much lower gains for other-CE students at the highest cost level. In grade 3, lower gains at the high cost levels are obtained also for other-CE students in other-CE schools. We suspect that sometimes other-CE funds are expended to provide services at high cost to students because of special learning problems and such services may not be aimed directly at improving achievement.

Other significant findings worth noting include: consistently significant unadjusted treatment-effects for all measures of gain in grade 1; significant adjusted treatment-effect for z-score gain and VSS gain in grade 1; and significant adjusted main effects for the treatment factor and for CE category for both kinds of residual gain in grade 5. In all these cases, the directions of differences are in favor of CE students, Title I students in particular. The advantages for CE students are particularly noticeable when they receive services at high cost. In the remaining cases, significances are obtained infrequently and without any systematic pattern.

Conclusions from the Analysis of Variance. In summary, the evidence for positive relationships between achievement gains and amount of effort remains inconclusive. The results of these extra analyses do not offer a more promising future for the search of a critical level of instructional effort. However, they do provide more detailed and specific evidence for some positive returns from intensive instructional efforts than do the earlier results obtained with a regression approach using data for all CE students.

Further Analysis by Student Characteristics

The relationship between instructional effort and achievement growth may, in fact, be moderated by differing background characteristics: different kinds of students may benefit differently from increased services. If this were the case, it could help explain the inconsistent and generally insignificant relations between instructional effort and growth. In other words, by considering student characteristics, we may be able to clarify the picture.

In this section, we examine the relationships between achievement growth and effect for subgroups of CE students with different background characteristics. Our primary interest is in the interactions between cost level and student characteristics. Four student characteristics are used in the analyses: white/minority status, participation in free-meals program, need for CE as judged by teachers, and initial achievement quartiles. In Tables D-14 through D-17 of Appendix D, we tabulate the mean reading achievement gains by level of effort (cost) and groups of different student characteristics, one table for each of the four measures of gain. Tables D-18 through D-21 present parallel tabulations for math gain scores. Significant tests are provided for the adjusted effects of instructional effort, and the interaction between effort and student characteristics.

Results of the Analysis for Reading. Examining Tables D-14 through D-17, we find that few of the interaction effects are significant (at the .01 level). For the most part, we conclude that there is little interaction between effort and student characteristics in terms of reading growth. However, significant interaction effects are occasionally found between effort and race in grades 4 and 6 for some indexes of gain. In such cases, inspection of the mean gains reveals a trend of increasing gains with increased costs for minority CE students, but not for white ones. Additionally, the interactions between level of effort and participation in a free-meals program are significant for three measures of gain (except for z-score gain) in grade 5. In this case, there is not a systematic trend for relation between gain and cost for either the participants or non-participants. These infrequent instances of interaction appear to be not very meaningful and probably are best regarded as results of chance.

Adjustments made for the effects of student characteristics apparently have little influence on the significance of cost-level effects. From these tables, it can be seen that in reading, only a few adjusted cost-level effects are significant. Specifically, significant results are consistently obtained in grade 6 for all but one of the measures of gain. In this grade, adjustment for either race, free-meals participation, or CE need, results in a systematic trend showing an association of increases in effort with increases in gain. In fact, the same trend is observed even without adjustment for these characteristics, and also within each subgroup of different characteristics, indicating that there are no interactions involved.

The remaining significances for adjusted cost-level effects are found without any consistency over grades or measures of gain. In most of these cases, achievement gains tend to increase with cost until the high-average level and then drop off at the highest cost level, regardless of which student characteristic is employed as the adjustment factor. The evidence for this phenomenon is, however, not strong, and it might be largely a result of chance variations due to small sample sizes, although one might also suspect some inefficiency of services at unusually high cost.

In passing, it is of interest to note a few miscellaneous observations from these tables. *First,* in grade 1, but not in the upper grades, there is a consistent finding that non-white CE students tend to achieve appreciably higher gains than the white CE students at every cost level. This finding might suggest that because the home environment of the minority students provides relatively fewer opportunities for learning, they tend to benefit more from instruction at the outset of schooling in comparison with the whites. However, such advantage dissipates gradually as these students progress through the grades. A similar finding has already been noted in Chapter 3. *Second,* the present analyses fail to discover any striking differences among the measures of gain in their ability to detect cost-level effects.

Results of the Analysis for Math. Examining Tables D-18 to D-21 in Appendix D, we again observe few significant interactions between effort and student characteristics. The only consistent interactions are found between CE-need and cost level in grade 4, for all four measures of gain. In this case, average gain in math is monotonically and positively related to cost for CE students judged to have need for CE, but not for those without such need.

Considerably more significances for adjusted cost-level effects are found in math than in reading. Adjustments for white/minority status, participation in free-meals program, or CE-need systematically reveal significant main effects of cost level in grades 1, 4, and 6 with few exceptions. These findings are generally consistent over the four measures of gain. In grade 1, there is a tendency for achievement gain in math to increase with cost through the third cost level (high-average level), followed by a slight decrease at the highest cost level. In grade 4, there is a steady trend for math gain to increase with increased effort. In contrast, an aberrant data point exists at the third cost level in grade 6, where the average gain is usually low regardless of which index is used. As in reading, there is evidence that the non-white CE students in the first grade tend to benefit more from services at a high cost level than the white CE students, probably again explainable by their different experiences prior to the first grade.

Conclusions from the Analysis by Student Characteristics. There are few interactions between cost level and student characteristics with respect to their effects on the achievement growth of CE students. Furthermore, adjustment of the cost-level effects by the differences in student characteristics does not result in a drastic change of our previous conclusion regarding the weak relationship between achievement growth and instructional effort. It is, however, a consolation to note that there is some scattered evidence for positive relationships, and in no instance is prominent evidence to the contrary observed.

INSTRUCTIONAL EFFORT AND GROWTH IN PRACTICAL ACHIEVEMENT

In addition to examining achievement gains on standardized tests, we also compared gains on the Practical Achievement Scale (PAS) in grades 4 through 6. Because it requires skills in both reading and math, PAS gains are presented for various levels of effort in reading and math. In Table 4-4, the raw-score gains are examined, while two kinds of residual-gain scores are examined in Table D-22 of Appendix D. Students represented in these tables are CE students in reading and/or math. As reading CE programs are much more widespread than math CE programs, fewer of these students participate in math CE than in reading. In general, reading CE students do not necessarily receive CE in math; however, math CE students frequently also receive CE in reading.

Each of the subtables in Table 4-4 provides data for examining the joint effects of instructional efforts in reading and math. The two-way analyses of variance for these data reveal very few noticeable main or interaction effects, and consequently we do not present the significant tests in the table. The lack of relationship between cost levels for reading and math services and gains in practical achievement can be characterized by the small proportion of the variance in gain scores attributable to the two cost factors. This proportion ranges between .6 to 1.2 percent across the measures of gains and the grades.

Despite the absence of significant effects, the mean gains show some interesting patterns in the three grades. In grade 4, the highest gains were achieved by students who received services at the highest cost levels in both reading and math. The relationship of marginal gains with effort in reading is non-monotonic, though slightly larger gains are attained at the highest cost level than at other levels. On the other hand, the marginal gains show a small, but monotonically increasing trend with increased effort in math. Furthermore, there is a tendency for PAS gains to be more spread out across levels of effort in math than in reading, suggesting that, at grade 4, the PAS may be more sensitive to differences in math services.

In grade 5, there is not a clear trend in the relationship between effort and gain. Marginal mean gains are not monotonically related to the levels of effort, differing insubstantially among the first three cost levels while showing a noticeable drop at the highest cost level. Although one is advised not to attach too much meaning to these patterns, the findings depart from our expectations. In grade 6, the marginal means for math cost levels show a similar departure from the monotonically increasing trend at the highest level as in grade 5. The relationship between marginal mean gains and reading cost levels is quite erratic, showing a zig-zag pattern.

Conclusions. Considerations of sampling errors and the lack of consistent findings (similarities as well as differences) lead us to conclude that there is little direct relationship between growth in practical skills and cost levels for reading and math services.

Table 4-4

Average Raw-Score Gains in Practical Achievement for CE Students, by Four Levels of Standard-Resource-Dollar Cost in Reading and Math

Grade	Math Cost Levels*	Reading Cost Levels*				
		Low	Low Average	High Average	High	Total
4	Low	3.92	3.46	3.49	4.67	3.76
	Low Average	4.55	3.91	3.70	3.61	3.97
	High Average	2.95	4.31	4.54	4.51	4.31
	High	4.11	4.56	3.85	5.54	4.84
	Total	4.23	3.91	3.93	4.51	4.07
5	Low	2.76	3.23	3.22	1.64	2.98
	Low Average	3.61	3.45	3.31	3.69	3.46
	High Average	3.53	3.45	3.55	4.23	3.64
	High	2.61	2.53	3.51	2.17	2.59
	Total	3.22	3.37	3.38	3.23	3.33
6	Low	2.21	2.75	2.81	5.50	2.60
	Low Average	3.00	3.00	3.30	3.13	3.08
	High Average	2.36	3.89	3.41	3.71	3.56
	High	3.46	3.12	2.88	2.89	2.95
	Total	2.75	3.15	3.21	3.21	3.11

Note: — Sample sizes can be found in Table D-22 of Appendix D.

*The four cost levels for reading and math are defined in terms of the mean and standard deviation (s.d.) of the total resource costs of reading/math services for all CE students within each grade as follows: Low = one or more s.d. below the mean; Low Average = zero to one s.d. below the mean; High Average = zero to one s.d. above the mean; and High = one or more s.d. above the mean. The lower end point of each level is excluded from that level.

SUMMARY AND CONCLUSIONS

The analyses presented in this chapter address the issue of a critical level of effort for narrowing the anticipated achievement gap between CE students and their educationally non-deprived peers. The purpose is to develop a model that conforms to a smooth and positive relationship between achievement growth and instructional effort, and to obtain, based on this model, an estimate of the level of effort that could be expected to raise the achievement of CE students to a level such that there is a meaningful reduction of their achievement gap.

Toward this end, linear and quadratic regression models were employed to examine the relationships between growth and effort. Four kinds of gain scores were used to measure the effects of instruction on growth, while the standard-resource-dollar cost for services was used to index the level of effort. A decision-based theoretical approach was applied to determine, wherever possible, a threshold value of the standard-resource-dollar cost for services at which CE students would begin to achieve an average gain greater than that expected of them in the absence of CE programs. The regression analyses produced little evidence for verifying the belief that achievement growth was a monotonically increasing function of instructional effort. As a result, we were not successful in proving the existence of a critical level of effort.

Nevertheless, in order to better our understanding of the complex relationship between achievement and instruction, we supplemented the theoretical approach by a number of descriptive analyses that explored the differences in patterns of instructional services received by CE students at different levels of effort and that studied the relationships of growth with effort for different groups of students by kinds of CE program (Title I or Non-Title I) and by student characteristics. These analyses reveal that, as intended, CE programs have provided services associated with high costs (mostly instruction in small groups and sometimes by special teachers) to a greater number of educationally deprived students than regular programs; but services at high cost do not clearly result in greater growth.

Only in a few occasions (notably in grades 4 and 6 for math), positive relationships are consistently shown; and, even in such cases, the relationships are weak. Although in many other cases there is a small tendency for positive returns in the intermediate levels of effort, this trend is frequently interrupted by an observed drop of growth at the very high level of effort. We suspect that the questionable efficiency of services at unusually high costs and the focus of higher-intensity services on lower-achieving students can hamper the normal effects of instructional effort on achievement.

Reviewing the results discussed in this chapter, we conclude:

- There is not enough evidence to support the concept of a 'critical level' of effort for narrowing the achievement gap between the disadvantaged and non-disadvantaged students.

- At the present time, we are not optimistic that a universally positive and monotonic relationship between academic progress and level of effort will be established empirically in light of the state-of-the-art in the development of 'good' measures for growth and effort.

CHAPTER 5. THE EFFECTS OF COMPENSATORY SERVICES AT DIFFERENT GRADES AND ON REPEATED PARTICIPATION

In this chapter, investigation of two important issues on the effects of CE are initiated with the cross-sectional data. The first concerns the best time to provide the services; that is, at what grades CE programs are more beneficial to the participants than at others. The second deals with the effects of repeated CE participation on achievement; that is, whether the history of participation, by itself, can influence the immediate effects of CE services.

Based on the cross-sectional data, the question of whether CE services are more beneficial at an earlier or later stage of schooling is answered by examining the differential effects of CE at elementary grades. The evaluation results in Chapter 2 are summarized in terms of four indexes for the growth of CE students (gains in vertical-scale scores, changes of percentile scores, and gains in excess of two different expectations derived from the performances of comparable non-CE students at CE and non-CE schools), and in reference to the respective indexes for needy non-CE students. We conclude from the cross-sectional analysis that, under current implementation, CE benefits its participants relatively more at the earlier grades, particularly in reading. However, it must be noted that beneficial effects of both reading and math CE are evident mostly in programs that receive funds from Title I (some may receive CE funds from other sources as well). CE students who participate in programs that received support exclusively from non-Title I sources show an accelerated growth only infrequently.

There are positive effects of reading CE primarily at the first three grades, and, in fact, it has little effect at grades 4 and 5. The results for math CE are slightly different: although it also has relatively larger effects at the lower grades (grades 1 and 3 specifically), there are no striking differences among the six grades. The relatively greater effects at the earlier grades are not accompanied by relatively greater CE efforts. Based on these results, we conclude that compensatory services can help accelerate the achievement growth of disadvantaged students more efficiently at earlier grades than at later ones.

The nature of the effects of repeated CE participation is studied by comparing the achievement growth between two groups of current CE students who did and did not receive the services in the preceding year. Three hypotheses are formulated: the incremental effects, the diminishing effects, and the independent effects. The results are inconclusive regarding the relative validity of these hypotheses. At some grades, it appears that repeating participants gain more than the new participants, supporting the hypothesis of incremental effects. At others, the results appear to be the opposite, supporting the hypothesis of diminishing effects. The cross-sectional data, which lack accurate information on the entire history of students' CE participation, cannot provide a satisfactory resolution of the issue. We hope that a better picture of the effects of continued participation will emerge from later analyses of the longitudinal data.

In the preceding chapters, we examined the achievement of CE students, comparing this with that of various groups of non-CE students and with statistical expectations, in order to evaluate the effects of CE programs. We also investigated the relations of achievement gains to receipt of instructional services to determine what kinds and amounts of services are required to raise the achievement of CE students. There remain many other questions that can be addressed, at least partially, with the first-year data. Before we conclude Part I of this report, we take up two more issues. (1) *Do the effects of CE programs differ among grades?* and (2) *Does the history of participation affect the achievement growth of current CE students?*

The first-year data are by no means adequate for addressing these questions; nevertheless, we wish to explore the data so that useful information can be obtained to aid further inquiries. Our ultimate goal is to determine the best time to provide CE services, and how long they should continue. The answers to these questions are basic to effective program implementation. For instance, if CE programs have greater effects on achievement growth at the earlier grades and the effects appear to diminish when the services are prolonged, school administrators would be wise to emphasize compensatory services at earlier grades and to distribute the services to more low-achieving students by limiting the length of participation.

In this chapter, the investigations of the long-term effects of CE are initiated with the first-year data. These investigations are intended to aid us in resolving the issue on how the effects of CE are related to the length and the pattern of participation. Full answers to this question will be provided in Report 14, where longitudinal data over a three-year span will be analyzed.

In the first question, we ask whether compensatory education is more beneficial when received at some grades than at others. Because Title I programs have not been fully funded at the appropriations level, school districts are not able to serve all their low-achieving students. Frequently, local administrators have to decide on what grades (and what skill areas) to concentrate CE services. In making the choices, they may consider not only the educational needs at different grades, but also the trade-off between services for one grade and the other in terms of expected benefits for the educationally deprived students. It is possible that, since learning of complex skills at higher grades requires proficiency in elementary skills introduced earlier, CE services can be most helpful when provided at the early stages, before the problems become serious and beyond remedy. Accordingly, we expect to see greater effects at the lower grades. This expectation is reminiscent of a familiar dictum in medicine: early treatment brings greater hope of cure, while delay in treatment allows disease to grow out of control. A counter-argument, which finds no analog in medical treatment, is that at the beginning, the basic skills are simple to learn even for the disadvantaged students, so that additional assistance is hardly necessary and, if provided, would have little effect. Therefore, the effort could be saved for students in the upper grades who without special help are likely to lag behind. If this is the case, the effects of CE would be greater at the later grades.

Which of these two situations is closer to the reality? In this chapter, we compare the effects of CE among grades on the basis of cross-sectional data in order to find an approximate answer to this question. The issue will be addressed again in two subsequent reports (Reports 12 and 14) which will study the achievement patterns of the same students over three consecutive grades to provide a more accurate answer. Whether CE is more effective at one grade than at another is not simple to determine. We cannot compare the effects of CE across the grades on equitable terms because the participants at different grades may suffer from different degrees and kinds of achievement deficits, and receive different amounts of supplementary services. The effects of CE could be greater at some grades because greater efforts have been invested or because the participants' learning problems are less severe or easier to overcome. A clear judgment on the differential effects of CE by grades would be impossible considering the uncontrollable nature of CE treatments. Being aware of this difficulty, we have confined our analysis to a narrower question: *Under current practices, do CE students achieve more, relative to expectations, at some grades than at others?* However, we will provide the readers with contextual information regarding the differences in CE efforts among grades so that they can see the results of our analysis in proper perspective.

Our cross-sectional analysis reveals that CE programs appear to be more effective in improving achievement at the earlier grades. Under current implementation, the effects of CE tend to vary with grades more in reading than in math. The effects in reading are primarily in the first three grades; in math, the effects can be detected in almost all grades, though these effects are still more evident at the lower grades. However, based on the extent of increase in services over those received by educationally needy students who attend non-CE schools, it appears that proportionally more supplementary services are provided to CE students at the upper grades. Within this context, we think that greater efficiency of compensatory services can be achieved at earlier stages of schooling.

The second question deals with the long-term effects of CE, which is the primary concern of the Sustaining Effects Study. The long-term effects can be examined in two directions. On the one hand, we are concerned about what happens to CE students when their compensatory services are discontinued because of their improved achievement. Do they fall back to their earlier low-achievement status, suggesting that the effects of CE are ephemeral; or do they maintain the improved status, showing that the effects are long-lasting? This question is addressed in Report 11 which examines the achievement pattern of former CE students who no longer receive the services. The report concluded that there was little evidence for dissipation of CE effects after discontinuation of services. This issue will be examined further in Report 15 with the three-year sample.

On the other hand, it is important for us to know whether CE programs remain beneficial for the students who participate year after year. One hypothesis in this regard is that the low-achieving students will achieve substantially better during their first year of participation, but that continued participation in subsequent years will not further the improvement much. There are many parallel phenomena of diminishing effects, as in medicine and economics. An example in medicine is that when a dose of a drug (e.g., a tranquilizer or an antibiotic) is prescribed for a patient, it relieves the treated symptoms the first time; however, if the problem persists for a period or reoccurs later, increasingly larger dosages are required subsequently to give the same relief (indicating a diminishing effect of the treatment), or, worse, the drug fails to help altogether (indicating a one-shot effect). This example deals with the effect of continuing the same treatment for a patient. A cross-sectional example would be that the same treatment brings less (or no) relief of the problems for patients who have received it before than for those who have not. For convenience, we will refer to this phenomenon as the hypothesis of diminishing or one-shot effects.

A second possibility is that the low-achieving students are so severely disadvantaged, they will not benefit from the supplementary services immediately, but the earlier services may have some delayed effects which serve to enhance the effects of subsequent services. As a result, an extended period of help may be required in order to achieve substantial progress, and the effects would increase with length of services. Examples of incremental effects are also common in medicine, economics, and other fields.

A third possibility is that the program effect at each year of participation is independent of the child's previous experience. Every time a child receives additional help, he benefits from it in the same way as he did earlier (whether or not the effects eventually accumulate is not pertinent to the distinctness of this possibility). In the medical analog, each dosage of a drug is expected to produce the same effect regardless of whether it has been used before. This third case will be called the hypothesis of independent effects.

Knowledge of which of the three hypotheses is correct can affect policies of student selection and allocation of services in compensatory programs. If the effect of CE is mostly realized at the first time of participation, and the funds are not sufficient to serve all deprived children in a single year, the eligible students may alternate participation in different years. Conversely, if the effect is incremental, we may want to emphasize long-term services for the most needy instead of intermittent services for all needy. In the third case, where previous experience does not influence the result of current participation, emphasis may be placed on certain grades when the programs are expected to be most effective.

The relative validities of the alternative hypotheses are, therefore, of interest to us. An ideal design for testing these hypotheses would include three random groups of educationally needy students; the first group, G_0, will not receive any CE services for two consecutive years; the second, G_1, will receive the services in the second year only; while the third, G_2, will receive the services in both years. The achievement progress of each of the three groups would be followed for the two years, and their achievement patterns would be compared to determine which of the three situations is best reflected in the data. Table 5-1 illustrates such a design and Figure 5-1 explains the results that could be expected under each of the different hypotheses.

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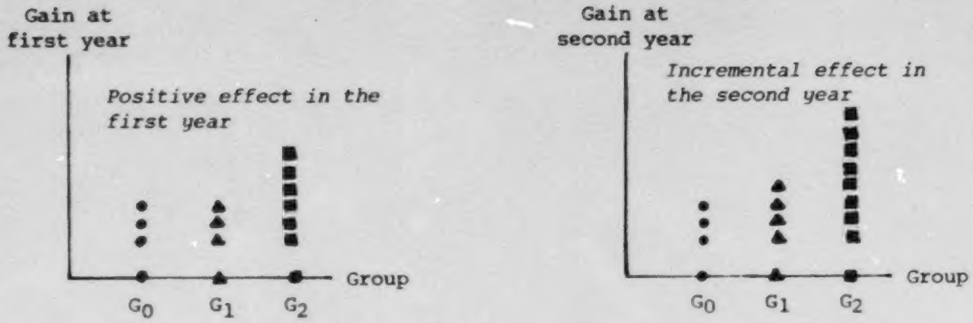
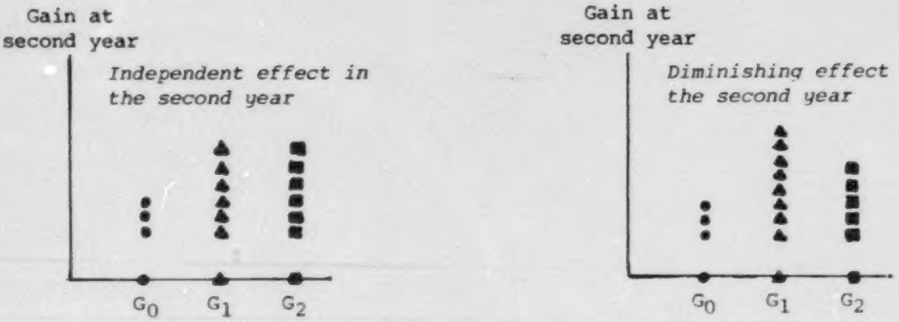


(a) Achievement Gains in the first year, showing a positive effect of CE.

(b) Achievement Gains in the second year, showing an incremental effect of CE with continued participation.



(c) Achievement gains in the second year, showing an independent effect of CE with continued participation.

(d) Achievement gains in the second year, showing a diminishing effect of CE with continued participation.

Note. — Group G_0 received no CE services in either year; Group G_1 received CE in the second year; and Group G_2 received CE in both years.

Figure 5-1

Expected Achievement Gains for Three Hypothetical Groups of Students Having Different Histories of CE Participation

Table 5-1

An Ideal Design for a Two-Year Evaluation for Assessing the Effects of Repeated Participation in CE Programs

Group	Receipt of CE Services	
	First Year	Second Year
G_0	No	No
G_1	No	Yes
G_2	Yes	Yes

In part (a) of Figure 5-1, a positive effect of CE is verified by the larger achievement gain in the first year for group G_2, which received CE in that year, than for the other two groups that did not receive the services that year. Part (b) shows the hypothetical results under the assumption of incremental effects of continued CE participation. There, the rank orders for the groups with respect to the average gain in the second year are, from large to small, G_2, G_1, G_0. Under the hypothesis of independent effects, the average gains would demonstrate the rank orders represented in part (c); G_2 and G_1 achieve similar gains in the second year, but G_0 has a smaller gain. Finally, suppose repeated participation causes the effects of CE to diminish. We would expect the results shown in part (d); in the second year, both G_1 and G_2 gain more than G_0, and G_2, having participated for the second year, gains less than G_1, the new participants.

Thus, if this ideal design were feasible, we would be able to resolve the issue with ease, unless the actual situation is more complex than what we have described so far. As an example, it is conceivable that the effects of CE might be incremental over a certain period of continued participation and then begin to diminish with further participation. In such a case, more than two years of data would probably be required to reveal the phenomenon. Clearly, the data employed in this report do not afford us a thorough analysis for either the simpler or the more complex cases.

For the present analysis, we only have one year of achievement data, and participation records are obtained only for the 1976-77 school year. In order to approximate the design shown in Table 5-1, we have to use retrospective information on student receipt of CE in preceding year (1975-76), as reported by homeroom teachers. The accuracy of such data, however, may be in question as suggested by the teachers' inabilities to identify correctly the current CE students (see Report 5 and later discussions in this chapter). Another problem is that the two groups of current CE students who did not participate in the previous year are likely to be non-equivalent with respect to ability and backgrounds. Although some pre-existing differences can be adjusted statistically, their confounding effects in the comparison of achievement growth between groups cannot be removed totally. The imperfection of our data for evaluating the hypotheses on the effects of repeated CE participation is further underscored by the differences in supplementary services received by the groups. Without complete control for these differences, it would be difficult to prove that repetition of participation can or cannot, by itself, influence the effects of CE.

Despite these difficulties, we decided to compare the achievement between two groups of CE students in 1976-77 who did and did not receive the services in 1975-76, as a partial investigation of the long-term effects of CE. With our approach, we remind the reader that the immediate effects of

CE in 1975-76 cannot be verified (as in part (a) of Figure 5-1) because we do not have achievement data for that year. Nevertheless, these missing data do not deny us the opportunity to uncover useful information regarding the issue of the effects of repeated CE participation.

As explained in parts (b), (c), and (d) of Figure 5-1, the relative validities of the three competing hypotheses can be assessed primarily by the relative gains in the second year between the CE students with and without previous participation in the first year (that is G_1 and G_2 in our idealized design). Therefore, our comparisons will concentrate on these two groups of current CE students and omit the group of non-CE students (i.e., G_0 in Table 5-1). As necessary, the achievement gains need to be adjusted for pre-existing differences so as to alleviate their confounding effects.

In summary, the second question which concerns the long-term effects of CE will be answered by examining the achievement growth of two groups of current CE students. If the students who repeat participation in a successive year show greater growth than the new participants, the data favor the hypothesis of incremental effects. On the other hand, if, *ceteris paribus*, the 'first-time' participants benefit from the current services more than the repeaters, the data support the hypothesis of diminishing or one-shot effects. In the event that there are no differences between the two groups, the hypothesis of independent effects is supported.

Because the function of CE programs is to provide additional instruction to the participants, the long-term effects of CE cannot be meaningfully examined without consideration of the different instructional services received by the students. Suppose that the new participants received services that are different from those received by the repeaters; we need not expect them to benefit equally from the programs even if the effects of current services are not influenced by participation history. Thus, it is important that, in our analyses, we explore various methods to take into account the effects of instructional services so that proper tests of the hypotheses are insured. For this reason, instructional service constitutes an important factor in the analyses to be discussed later.

The results of our analysis are mixed: the data at different grades and for different skill areas appear to support different hypotheses. For both reading and math, the data in grades 1 and 3 tend to favor the hypotheses of incremental effects as participation continues in a successive year. On the other hand, there is some evidence that the beneficial effects of CE may be diminishing for the students who repeatedly receive the services. Such diminishing effects may be suspected on the basis of the data in grade 5 for math. The inconclusive findings are somewhat disturbing and the issue awaits further clarification.

DIFFERENTIAL EFFECTS OF CE BY GRADES

In Chapter 2, we employed an array of comparison standards to assess the effects of CE at each grade. Except for some occasional remarks, the question of whether CE has greater effects at some grades than at others was not addressed explicitly. We now review and reorganize the results in that chapter in order to deal with this issue formally.

Because the achievement process at each grade need not be identical, the growth curve over the elementary grades may be nonlinear, as suggested by the cross-sectional data plotted in Figures 1-1 and 1-2 of Report 9. Similar nonlinear trends may also be suggested by the data presented in Figures 2-2 and 2-3 of Chapter 2. This nonlinear trend indicates that, in terms of vertical scale scores (VSS), the achievement gains for the same students may differ substantially as they progress through the grades. If this were the case, it would be inappropriate to compare the relative effects of CE directly in terms of increased VSS gains over the expectations among different grades.

One way to overcome this difficulty is to choose a common frame of reference for all grades and express the gains relative to the respective reference for the purpose of comparisons. Following this strategy, we express the average VSS gain for CE students as a percentage of the gain for a typical performer at the same grade (that is, the VSS gain for the 50th percentile in the achievement norm). The percentages at different grades can then be compared to determine if CE students make proportionally larger gains at some grades than at others. With similar considerations, the residual gains (observed minus expected posttest scores), which were also used in our earlier evaluation of CE programs, were transformed into percentages of the expected scores. In this way, we can compare the effects of CE among grades in terms of proportional improvements relative to the corresponding expectations.

For the fourth index of achievement growth, the z-score gain, which was also used in our previous analyses, we present simply the percentile scores at both pretest and posttest administrations to show the pattern of changing statuses for the CE students. At any grade, it is intuitively plausible to assume that students will maintain the same percentiles (i.e., have a z-score gain equal to zero) in the normal educational process, unless there are special interventions. The extent to which the achievement of CE students surpasses or falls below this expectation can be gauged in a straightforward manner by the rise or fall of their average percentile rank at the end of the school year; and there is little need to devise a special index for the comparisons among grades.

Thus, the findings in Chapter 2 are summarized by grades in Appendix E (see Table E-1 for reading and Table E-2 for math) either in terms of the relative indexes or the actual data at pretest and posttest. In these summaries, we present the data not only for the different groups of CE students (Title I students, Other-CE students in Title I schools, and CE students in non-Title I schools) but also for two groups of students who were judged to have need for CE but did not receive the services, either because their schools did not offer CE or because funds were not sufficient to extend services to them.

The data for these two comparison groups of non-CE students are added to the tables in order to provide a further basis for judging the relative effects of CE over grades. These data are especially valuable when the index for VSS gain is used. In the natural course of learning, educationally deprived students can lose (or even gain) ground to the normal students by relatively different amounts at different grades. These differences among grades can result from the different paths of maturation for the disadvantaged and regular students. In particular, such differences can arise artifactually as a result of employing achievement tests that fail to measure properly the whole range of skills learned by different kinds of students at each grade.

In the case of residual gains, the relative index is not obviously affected by the different maturation processes for students with different backgrounds, as such differences have been taken into account in the statistical models that generate the expectations. Nevertheless, the data for needy non-CE students are compiled to allow us to check further the utility of the prediction models that are developed on the basis of data for all non-CE students. In order for the models to be useful, they must accurately predict the achievement of educationally needy students who did not receive CE; otherwise, we cannot be confident of the appropriateness of residual gains as measures of the effects of CE.

Similarly, the pretest and posttest percentile scores for the needy non-CE students are examined in order to assess the validity of the percentile-maintenance expectation. In addition, these data can reveal possibly different changes of achievement status for the deprived students at different grades when there is no CE. Such differences need be considered when we compare the effects of CE among grades.

In what follows, we will examine the data presented in Tables E-1 and E-2 to shed light on the issue concerning the differential effects of CE according to grades.

The Effects of Reading CE by Grade. Table E-1 of Appendix E presents the summary data for reading achievement. Based on the average percentile scores, we find that, among CE students, only Title I students consistently show an improvement of their achievement standings at posttest. The increase in percentile scores achieved by Title I students is the largest at grade 3, and the second largest at grade 4. However, at both of these grades, needy non-CE students also show an improvement of their status so that we are not certain that the increase for Title I students is entirely attributable to their participation in CE.

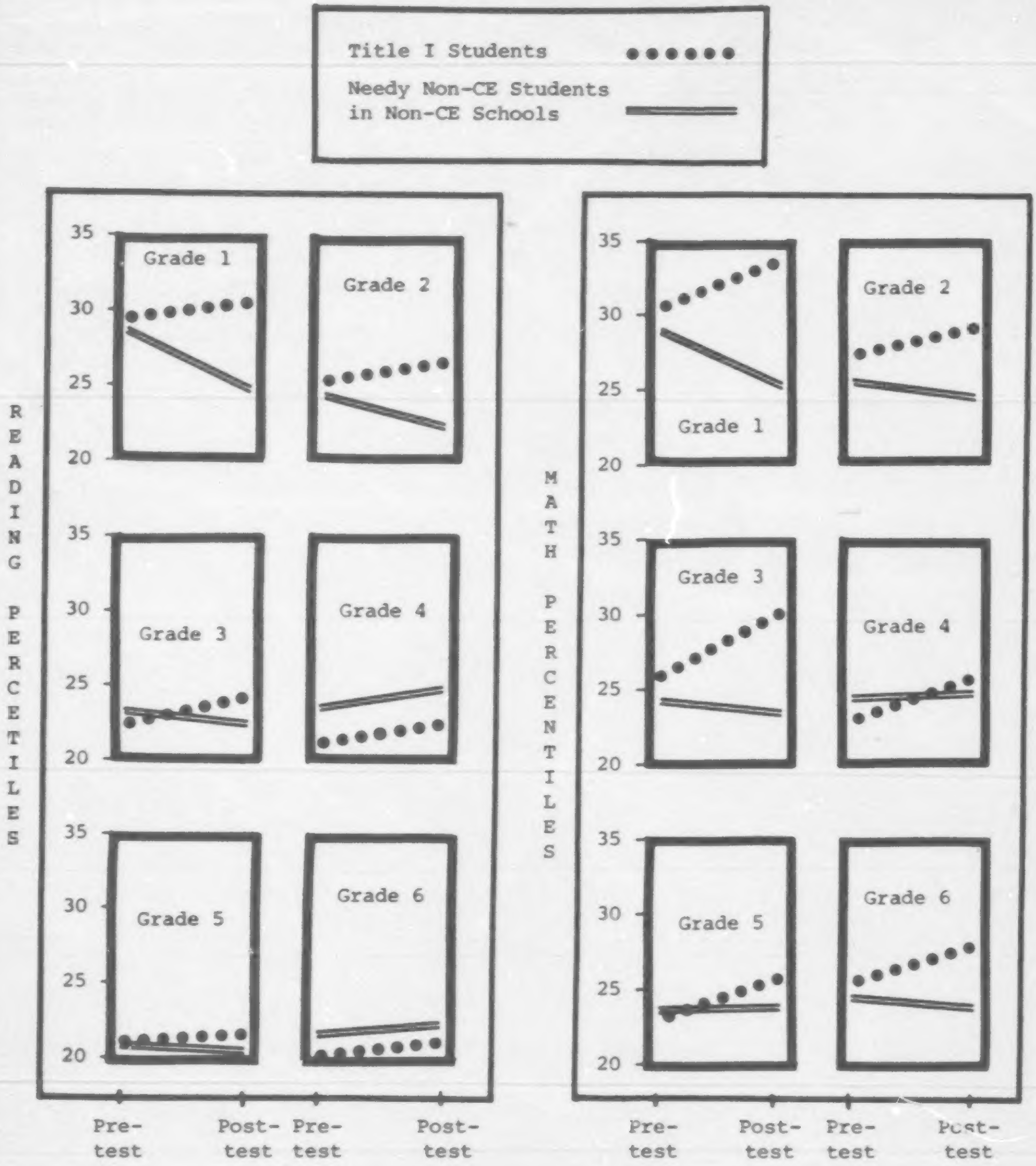


Figure 5-2

Average Pretest (Fall) and Posttest (Spring) Percentile Scores for Title I Students and Non-CE Students Attending Non-CE Schools and Judged as Having Need for CE by Their Teachers

Indeed, the validity of the percentile-maintenance expectation appears to vary with grades when it is applied to the achievement of educationally needy students. For this reason, it would be more appropriate to base our judgment, regarding the relative effects of CE, on the difference in percentile changes between CE and needy non-CE students at each grade. To facilitate the comparisons, the pretest and posttest percentile scores of Title I students and students in non-CE schools who were judged to have need for CE are plotted in Figure 5-2 by grades. The slope of the line segment that connects the pretest and posttest scores of the same group indicates the direction and magnitude of the percentile change for that group. A positive slope shows an improved status, while a negative slope shows a deteriorated status; and the steeper the slope, the greater the change of status.

From these plots, we see that, with the performance of the needy non-CE students as a reference base, the improvement of Title I students is more pronounced at the first three grades than at others. This result is consistent with that of the Compensatory Reading Study (Trismen et al., 1975), which found CE in reading to be more effective in grade 2 than in grades 4 and 6. Additionally, we note that, at most grades (grades 1 and 2 in particular), the comparison non-CE group falls further behind at the end of the school year, suggesting that they have needs for special assistance to curb such decline.

Could the greater effects of Title I at the earlier grades chiefly result from greater efforts? To explore this possibility, we present in Table 5-2 the total instructional services received by these two groups of students, and compare the program efforts at different grades in terms of percent of increased services for Title I students over those received by educationally needy students at non-CE schools. The data reveal that 'supplementary' services received by Title I students are proportionally greater at the upper three grades. Thus we believe that the relatively greater effects of Title I at the lower grades suggest that earlier help is more beneficial, perhaps because it is provided in time.

Table 5-2.

Comparisons of Reading and Math Services Received by Title I Students and Non-CE Students at Non-CE Schools Who Were Judged To Have Need for CE by Their Teachers

Grade	Reading Services Received			Math Services Received		
	Title I Students	Needy Non-CE Students at Non-CE Schools	% Increase for Title I Students*	Title I Students	Needy Non-CE Students at Non-CE Schools	% Increase for Title I Students*
	Hours of Instruction Per Year					
1	316.5	310.4	2.0	170.9	172.3	-0.8
2	298.1	255.2	16.8	179.7	161.0	11.6
3	272.1	259.8	4.7	186.5	174.8	6.7
4	248.7	197.2	26.1	198.5	169.8	16.9
5	227.4	189.9	19.7	202.1	163.8	19.0
6	226.5	190.3	19.0	188.8	174.3	8.3
	Standard-Resource-Dollar Costs for Instruction Per Year					
1	428.7	339.5	26.3	203.0	144.3	40.9
2	428.4	297.8	43.9	198.8	135.0	47.3
3	392.3	305.2	28.5	228.4	150.5	51.8
4	384.4	226.2	69.9	255.0	149.1	71.0
5	333.8	219.8	51.9	260.0	158.8	63.7
6	336.9	207.8	62.1	241.3	176.3	36.9

*Percent of increase for Title I students is obtained with services received by needy non-CE students at non-CE schools as the reference base.

By comparison, there is little evidence that there are differential effects of non-Title I CE programs at elementary grades. We remind the reader that in fact these Other-CE programs appear to have little overall effect on the achievement of their participants who do not also receive Title I services.

With respect to other indexes, the same conclusions, indicating larger effects at earlier grades, can be generally reached with proper comparisons. Hence, we will not repeat the discussion here; the interested reader may study the data in Table E-1.

Before we discuss the findings in math, there are a few additional results which, while not addressing the issue directly, are worth noting: the first concerns the growth rate of educationally deprived students; the second and the third deal with the usefulness of statistical models in the evaluation of CE effects.

- In terms of VSS gain, both groups of needy non-CE students (at CE and non-CE schools) consistently grow at a rate below that of the median performers (the hypothetical students who perform at the 50th percentile). The only exception is found at grade 4 where these students grow at a slightly higher rate than that of a typical student. Although Title I students (and occasionally Other-CE students) exhibit a faster rate of growth than that of these comparison non-CE students, they still grow at a slower rate than the 'median' students. Thus, the cross-sectional data suggest that, in an absolute sense, the achievement gap between the disadvantaged and non-disadvantaged students tends to increase with grades. Where there are positive effects, Title I programs help in reducing this increasing gap.

- In most cases, the prediction model developed on the basis of data for students at non-CE schools (the Model A described in Appendix B5) can estimate very well the posttest performance of needy non-CE students at these schools. (For a perfect prediction, the relative index with respect to Residual Gain A in Table E-1 would be 100 for this group.) The satisfactory validation of the model with the actual performance of this special group of students adds to our confidence of using the model to generate the expectations of CE student performance under no-CE situations.

- The prediction model calibrated with the data for non-CE students at CE schools (the Model B described in Appendix B5) frequently underestimates the actual performance of the needy non-CE students at these schools. Such bias in predicting the achievement of educationally needy students could partly be explained by the truncation of data in the low-score range as a result of excluding the data for CE students. This exclusion of data is necessitated by the desire to separate the effects of CE from regular achievement growth. The strategy, however, appears to result in the model's inability to provide accurate expectations for the low-achieving students; this deficiency clearly reduces the value of the model in judging the effects of CE.

For the math data presented in Table E-2 of Appendix E, we also arrive at similar findings. Therefore, the discussion of these results for math will not be repeated in the next section.

The Effects of Math CE by Grade. The summary data for math achievement are presented in Table E-2 of Appendix E. On the whole, similar conclusions can be obtained with respect to different indexes of the effects. We will therefore discuss only the results based on percentile scores since they are the easiest to understand. The reader is referred to Table E-2 for detailed information.

As in reading, the average percentile score of Title I students rises from pretest to posttest at all grades, whereas that for other-CE students tends to drop or remain the same. The two groups of needy non-CE students also show a decrease at the posttest. The change of status by the comparison non-CE students varies with grades, suggesting that the validity of the percentile-maintenance expectation may differ among grades. For this reason, we take into consideration the progress of the comparison non-CE students when comparing the relative effects of CE among grades.

In Figure 5-2, we present the average pretest and posttest percentile scores of Title I students and students judged to have need for math CE but attending non-CE schools. The graphs can be examined in the same way as explained earlier in conjunction with the reading data. From these graphs, we find that the effects of CE on the achievement of Title I students are relatively larger at the lower grades; however, these relative effects do not differ among grades as much as in reading. The improvement made by Title I students is the largest at grades 1 and 3; but at the remaining grades, Title I students also show noticeable improvements.

In order to see how the effects of CE may relate to program efforts, we show in Table 5-2 the percentages of increased math services received by Title I students, in reference to the services received by needy non-CE students at non-CE schools. The data in this table suggest that proportionally more additional services are extended to Title I students at grades 4 and 5. Thus, the data do not reveal a positive association between relative efforts and effects. Possibly because of the increasingly difficult learning materials that require comparatively more instruction for low-achieving students to master, the schools have decided to invest greater efforts at the upper grades. As a result, the relative effects at different grades do not necessarily reflect the existing efforts.

Clearly, the issue of differential effects by grades is a very difficult one to settle in view of the complex relationship between needs and efforts. While acknowledging this problem, we still think that the larger relative effects at earlier grades confirm our intuitive belief that educationally deprived students are more likely to benefit from earlier remedy.

Conclusions. Using different indexes for the effects of CE and taking into account the achievement progress of educationally needy students who do not receive CE, we find that there are some differential effects of CE by grades. In reading, the effects are relatively larger at the first three grades; and, in fact, there is little effect at grades 4 and 5. By comparison, the differential effects of math CE are not as pronounced. Although the relative effects of math CE are still greater at the lower grades (grades 1 and 3, in particular), there is evidence for a positive effect at every grade and the differences among grades are not large.

In both reading and math, the relative effects of CE do not have a positive relationship with the relative efforts at different grades. In terms of percent of increased services received by Title I students, as compared with the services for needy students at non-CE schools, the program efforts tend to be greater at the upper grades. We conclude from our analysis that, with comparable efforts, CE is likely to benefit its participants more when provided at the earlier stages of schooling.

Finally, we should note that the programs that consistently show positive effects are usually supported by Title I, and sometimes also by other-CE funds. However, the programs that receive only non-Title I support tend to have little effect. The diverse objectives of other-CE programs could probably explain these differential effects between Title I and non-Title I programs.

THE EFFECTS OF REPEATED CE PARTICIPATION

As explained in the opening of this chapter, the alternative hypotheses about the effects of repeated CE participation will be tested primarily by examining the achievement of CE students who have different histories of participation. We remind the reader that because of the limitation to a single year of data, we can only address three simple hypotheses; we will leave considerations of the more complex longitudinal hypotheses to subsequent reports.

The three competing hypotheses to be considered here are: the hypothesis of incremental effects, the hypothesis of diminishing effects, and the hypothesis of independent effects.

First, we will introduce the evaluation design that includes a major factor—history of CE participation, and a control factor—receipt of instructional services. Three kinds of gain scores will be analyzed with this design, each representing a different way to account for the influence of ability and backgrounds on normal growth. *Second,* we will discuss the differences, with respect to pretest achievement and receipt of instruction. This supplemental information is provided to assist in the proper interpretation of the results. *Third,* the results of the analysis will be discussed in terms of the effects of continued CE participation.

Evaluation Design

The evaluation design is explained in three parts: (1) a description of student grouping on the basis of participation history during the period of 1975-1977 school years; (2) a description of various methods for adjusting for the confounding effects of instructional services; and (3) a description of the dependent measures to be analyzed.

Student Grouping. The primary factor in the design is the student participation pattern in the school years 1975-76 and 1976-77. Following the layout in Table 5-1, our interest centers on two groups of 'current' CE students (participating in 1976-77) who did and did not receive CE in the preceding year (1975-76).

Student CE status in 1976-77 can be reasonably ascertained from the Compensatory Education Roster (CER) in which school coordinators recorded each student's participation in five different CE programs. For 1975-76, student CE receipt can only be determined from the retrospective reports by homeroom teachers. In the Student Background Checklist (SBC), teachers were asked to indicate whether their students received CE in 1975-76 and in 1976-77. The duplicated data for 1976-1977 (from CER and SBC) allow us to verify the teacher's ability to identify the CE students correctly.

In this regard, previous analyses (see Tables 3-29 and 3-30 of Report 5) revealed that teachers were not aware of the CE participation of a considerable number of students. For these students, we have some reason to suspect that their teachers may also be unable to provide accurate information about whether they received CE in 1975-76 because their teachers are probably unfamiliar with their educational records. Accordingly, we decided to separate these CE students from the others to form a third group.

As will be seen later, the group of CE students who are not so identified by their teachers tends to achieve better at the pretest and receives less services than those whose teachers have knowledge of their participation. This finding suggests that the third group of CE students may inadvertently miss some benefits of CE services because their teachers do not recognize their CE status and thus fail to provide them the intended special assistance. The separation of these 'misidentified' CE students into a distinct group can sharpen our analysis; as a result, more sensitive tests of the hypotheses may be accomplished.

In summary, CE students were divided into three groups (instead of two as originally planned) in terms of their participation records for two consecutive school years. Note that, for brevity, CE students are those who received CE in 1976-77 according to the CER data.

- *Repeated Participants.* CE students whose teachers reported that they received CE in both 1975-76 and 1976-77.
- *New Participants.* CE students whose teachers reported that they received CE in 1976-77, but not in 1975-76. (We call these students 'new' participants in order to differentiate them from those who also participated in the preceding year; however, they could have received CE in years prior to 1975, especially those at the upper grades.)
- *Misidentified Participants.* CE students whose teachers reported that they did not receive CE in 1976-77 (regardless of whether they received it in 1975-76 or not).

At this point, we should remark that because we can only trace the history of participation for two years, the analysis will not capture the total influence of previous receipt on the immediate effects of current services. This problem is particularly serious at the higher grades where students can have

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more complicated patterns of participation. For instance, a student may enter the CE program in one year, leave it in another, and then return to it in the third.

More important, because the selection of students to participate in CE is a dynamic process in which the lowest-achieving and lowest-growth students are the most likely to remain in the program longer, there are numerous threats to the validity of the comparison between groups of students with different histories of CE receipt. Specifically, these groups of students are not equivalent with respect to other achievement-related factors such as amount of services received, ability, and home environment. In what follows, we will explain how these threats may be lessened by controlling for service differences and by using indexes of growth that adjust for preexisting differences in ability and background characteristics. Nevertheless, statistical controls and adjustments are rarely adequate to solve the problem of non-equivalence completely.

Considering these difficulties, we emphatically forewarn the reader not to draw hasty conclusions from the results. Our analysis aims at adding to our knowledge with regard to the long-term effect of CE. It is a complex issue, and each investigation based on data over a truncated period of the entire education process is not expected to resolve it.

Adjusting for Differences in Receipt of Instructional Services. The three groups of CE students may receive different kinds and amounts of instructional services that can affect achievement growth. Therefore, in order to understand the effect of repeated participation per se, we need to separate the confounding effect of instruction from the total effect of participation history. Three methods are employed to adjust for the instructional differences among the groups.

In the first method, we enter 'type of services received' into the design as a second factor so that the effect of participation history can be evaluated with adjustment for the instructional effect. Because CE services are characterized by special kinds of services, we propose to classify the instructional services into two major categories: 'special' and 'non-special'. The special category includes instruction by classroom teachers in groups of six students or less, instruction by special teachers, and assistance by paid aides/assistants. The non-special category includes instruction by classroom teachers in groups of seven students or more, and work with tutors or independently. Earlier analyses (see Chapter 3) indicate that services for CE students are increased primarily in the category of special instruction, which is also likely to differentiate the services between different groups of CE students. Additionally, the two categories of instruction appear to have different relationships with achievement growth. Thus, the distinction between special and non-special services could be useful for the purpose of controlling for instructional differences.

The annual receipt of instruction in each of the two categories is dichotomized at the respective population mean (see Table E-3 of Appendix E) to differentiate the services received by the students. Thus, four types of instructional services are defined jointly on the basis of the two dichotomies; each group of CE students is accordingly subdivided into four groups corresponding to these four types of services.

- *High/High Group:* Students who received an above-average amount of special instruction and an above-average amount of non-special instruction.

- *High/Low Group:* Students who received an above-average amount of special instruction, but a below-average amount of non-special instruction.

- *Low/High Group:* Students who received a below-average amount of special instruction, but an above-average amount of non-special instruction.

- *Low/Low Group.* Students who received a below-average amount of special instruction, and a below-average amount of non-special instruction.

Although the four types of services are discrete, they are partially ordered with respect to total amount and intensity of services. The High/High group receives services that are generally of greatest amount and highest intensity, in comparison with the other three groups. The services received by the Low/Low group tend to be in the smallest amount and the least intensive. On the average, the High/Low and Low/High groups receive a similar amount of services but the High/Low group receives more intensive services.

With this design, we employ the technique of analysis of variance (ANOVA) to assess the effects of participation history, while the effects of instructional services are statistically controlled. Additionally, we can examine, in this context, the interaction between the two factors, participation history and type of services. A substantial interaction-effect could suggest that repeated CE participation can have different influences on achievement growth, depending on the type of services provided.

The second method uses an analysis-of-covariance (ANCOVA) approach. The discrete type of services would be an appropriate control factor if it could capture the total relationship between services and growth. In reality, the relationship is complex and unknown to us. For this reason, it is important that we explore other ways of adjustment also.

As an alternative, the instructional differences may be adjusted for based on the assumption that growth and services are linearly related. Such relationships were assumed when we examined the effects of instructional services on achievement in Chapter 3. There, the instructional services were described by three composites: H_S, hours of special instruction; H_R, hours of regular instruction; and H_I, hours of work with tutors or independently. (Note that now the category of non-special instruction in the preceding method is split into H_R, and H_I. For the rationale of constructing these composites, the reader is referred to Chapter 3.) Similarly, we propose to use these same composites as the covariates to adjust for instructional differences in the present analysis. In this way, the adjusted means for achievement growth are compared among the three groups of CE students to determine the effects of participation history.

In the third method of adjustment, a different measure of instructional services is used. So far we have considered only number of hours as the measure of instructional services received. Because the time measure does not reflect the intensity of services, we separately measured the instruction in settings of different labor-intensity (e.g., special vs. non-special instruction). An alternative measure that takes both the quantity and intensity of services into account is the Standard-Resource-Dollar cost for services. This cost measure reflects the labor-intensity of services by assigning higher cost to more intensive instruction (see descriptions in Chapter 3). In order to see if adjustments based on different measures of services yield different results, we propose to use the Standard-Resource-Dollar cost as the measure of instructional services in the third approach.

The same measure has been used in Chapter 4 to investigate the relationships between instructional effort and achievement growth. There we found that such relationships could be examined more clearly by dividing services into discrete levels of effort than by regression models. Therefore, the adjustment for instructional differences as measured by the Standard-Resource-Dollar cost is accomplished by introducing into the analysis a second factor that comprises four levels of instructional effort. As defined in Chapter 4, the four levels of effort are:

- *High.* The Standard-Resource-Dollar cost for total services exceeds the mean cost for all CE students by at least one standard deviation.

- *High Average.* The Standard-Resource-Dollar cost for total services exceeds the mean cost for all CE students by less than one standard deviation.

- *Low Average.* The Standard-Resource-Dollar cost for total services falls below the mean cost for all CE students by less than one standard deviation.

- *Low.* The Standard-Resource-Dollar cost for total services falls below the mean cost for all CE students by at least one standard deviation.

Accordingly, each group of CE students is subdivided into four groups by the level of effort that represents the services it receives.

Thus, the third method is similar to the first except that the level of instructional effort replaces the type of services as the control factor. The history of participation remains the primary factor in the design. Again, the effect of repeated CE participation can be evaluated conditional on the level of effort; whether the effect of participation history varies with the level of effort can be determined by the interaction between the two factors.

In summary, the three methods for removing the confounding effects of instructional services are:

- Use of types of services as a cofactor.
- Use of three service composites as covariates.
- Use of level of effort as a cofactor.

Dependent Measures To Be Analyzed. With each method of analysis, three indexes of achievement growth are examined:

- *Z-Score Gain.* Z-score at posttest minus that at pretest, where Z-score is the standardized normal deviate associated with the percentile score.
- *Residual Gain A.* Observed posttest Vertical Scale Score (VSS) minus the expectation, where the expectation is set by a prediction model developed on the basis of data for all students attending non-CE schools. The predictors used are pretest score and background characteristics.
- *Residual Gain B.* Similar to Residual Gain A, but the prediction model is developed on the basis of data for non-CE students attending CE schools. (See Appendix B5 for detailed descriptions of the residual gains.)

Each of the gain scores represents a different way of adjusting for pre-existing differences among the groups. The VSS gain is not considered because the differential pretest achievement and growth rate are more likely to threaten the validity of the analysis based on it. Preliminary analyses, however, suggest that the results based on VSS gains are not contradictory to those obtained with the three indexes listed above.

In addition, the pretest scores are analyzed with similar designs to examine the initial achievement differences among groups of students who have different histories of CE participation and received different types or levels of services. We are interested in learning how achievement status may affect the pattern of CE participation. Moreover, the pretest differences among the groups can aid us in interpreting the results of analysis on gain scores.

Group Differences in Pretest Achievement and Receipt of Services

In view of the selection policy of CE programs, it is reasonable to expect students having different histories of participation to differ with respect to achievement. It is also conceivable that CE students are provided different amounts of supplementary services according to their needs. For instance, there is some evidence that amount of services received correlates negatively with achievement (see Chapter 3). Accordingly, we may expect the long-term and the short-term CE students (in the present case, the repeated and the new participants) to receive different services because of their different needs. Before we examine the effects of repeated CE participation, it is useful to present some findings in these regards in order to further our understanding of the CE process. For convenience, we will discuss the findings for reading and math separately.

Reading Achievement and Services. The results of the ANOVAs for reading pretest scores are summarized in Appendix E. In Table E-4, the analysis involves two crossed factors, participation history by type of services; whereas in Table E-5, the second factor is replaced with level of effort. We will discuss only highlights of the findings below; for details, the reader may study the tables in the Appendix.

In Figure 5-3, we plot the average pretest scores for the three groups of CE students by grade. The figure clearly shows that, at the pretest, the misidentified participants (labeled as 'uncertain' in the figure) achieve substantially better than the others. This result suggests that there is a tendency for teachers to associate student's CE status with achievement; they have difficulties identifying the participants who achieve above the typical level for CE students. This conjecture is supported by the finding in Report 5 that these misidentified CE students are also judged to have no need for CE by the same teachers.

By comparison, the achievement differences between the repeated participants (participating in both years) and the new participants (participating in 1976-77 only) are generally small, though the latter tend to have slightly higher pretest scores. We suspect that this is a result of CE selection practices. The borderline achievers in a previous year (those who achieved just slightly above the selection criterion) may become participants in the following year as replacements for the earlier CE students who have been disqualified because of improved status. At the same time, the lowest-achieving students are the most likely to remain as participants in successive years. Consequently, the short-term participants are less disadvantaged and achieve better relative to the long-term participants.

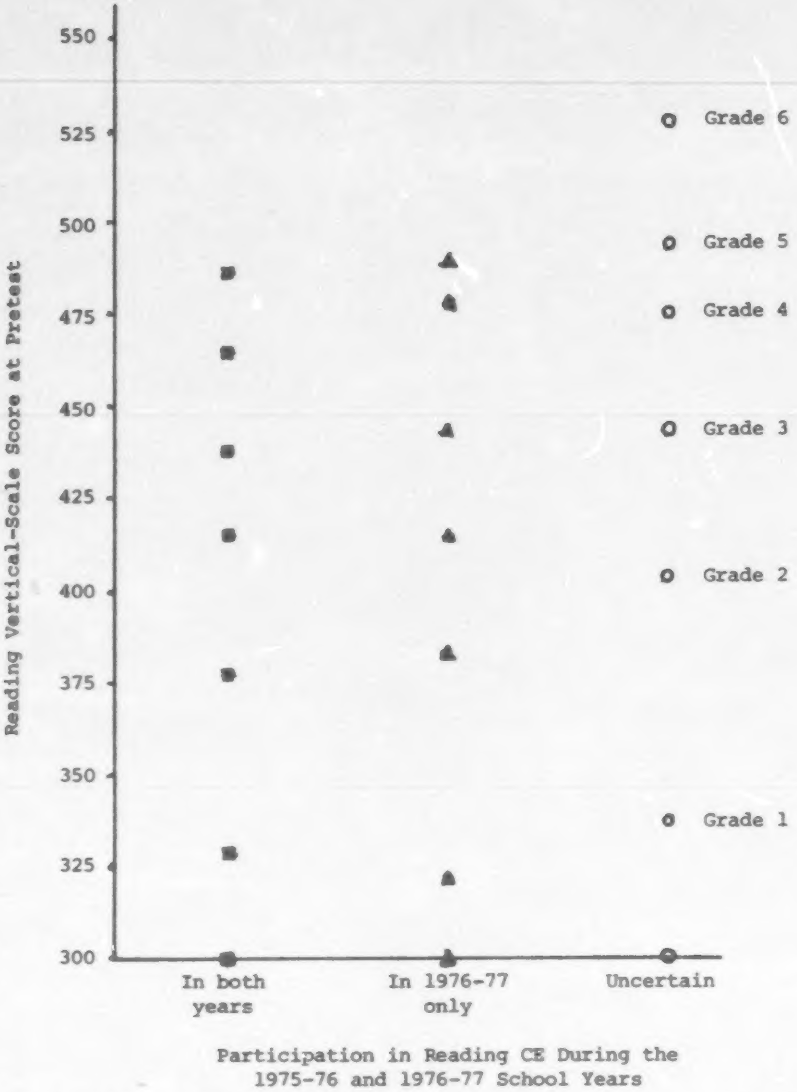
A notable exception is obtained at grade 1, where the average score of the repeated participants exceeds that of the new ones. This reversal in the direction of differences may be explained by the fact that repeated participants must have some previous school experiences (they received CE in kindergarten, participated in some early-childhood CE programs such as Headstart, or flunked the first grade). Earlier Headstart evaluation revealed that children having prior experiences with Headstart or other preschools tended to achieve better at the pretest than those who did not have such experiences (Coulson, 1972). Similarly, the higher pretest scores of the CE-repeaters at grade 1 could be largely a reflection of the benefits of their earlier school experiences.

The data in Table E-5 also show a clear trend that students with lower-achieving status (as indicated by lower pretest scores) receive more services (more hours and/or greater intensity), suggesting a practice of allocating services in accordance with educational need even among CE students.

To examine further how receipt of services may be related to the history of CE participation, we present in Table 5-3 the distributions of services within each group of CE students. The data in this table reveal that a substantially smaller percentage of the misidentified participants receives services at the high cost level, in comparison with either the repeated or the new participants. However, receipt of services in a given year seems to have little relation to history of participation. The misidentified participants receive less services probably because they are less needy, although we may also suspect that they miss some services because of their ambiguous status.

Math Achievement and Services. The results of the analysis for math pretest scores are presented in Appendix E (Table E-6 for the 'participation history by type of services' design and Table E-7 for the 'participation history by level of services' design).

Figure 5-4 highlights the principal finding from these tables. As in reading, the misidentified participants are clearly higher-achieving than the other participants. Except at grade 1, the new participants tend to achieve better at the pretest than the repeated participants. Again, an opposite direction of the differences between the repeated and new participants is evident at the first grade; and it may be explained similarly by the extra school experiences of the repeaters.



Note. — Students who received CE in 1976-77 according to records in the Compensatory Education Roster, but whose teachers did not identify them as participants in that year, were classified into the group having 'uncertain' CE-participation pattern.

Figure 5-3

Average Reading Scores at Pretest for Reading CE Students by Participation Pattern During the 1975-76 and 1976-77 School Years

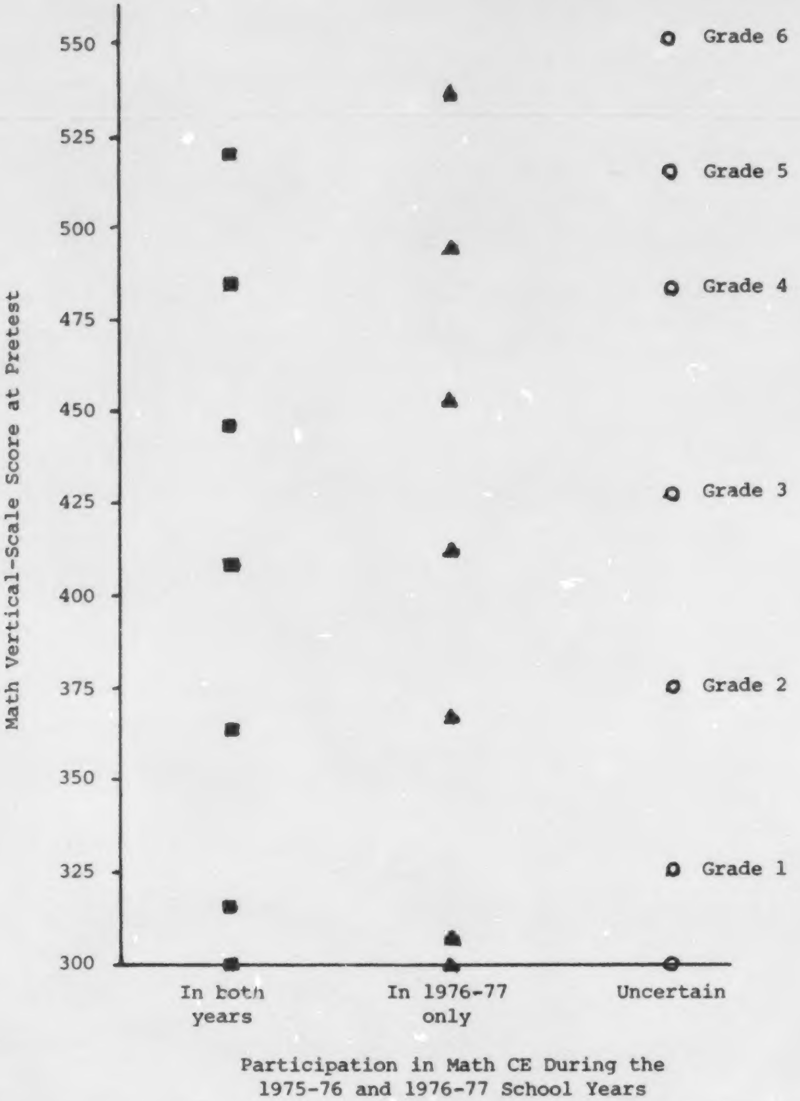
Table 5-3

Percentage of Reading CE Students Receiving Services at Four Levels of Effort, by Participation History

Grade	CE-Participation in 1975-77 School Years	Levels of Cost for Reading Services**				Total
		High	High Average	Low Average	Low	
1	In both years	16.0	31.8	40.4	11.9	100.0
	In 1976-77 only	21.7	28.3	43.0	7.0	100.0
	Uncertain*	9.4	23.5	49.1	18.1	100.0
	Total	14.9	27.0	45.0	13.1	100.0
2	In both years	15.4	33.9	41.9	8.8	100.0
	In 1976-77 only	19.5	32.4	41.3	6.8	100.0
	Uncertain*	8.3	22.4	49.2	20.0	100.0
	Total	13.6	29.2	44.6	12.7	100.0
3	In both years	19.6	32.1	39.7	8.6	100.0
	In 1976-77 only	19.7	35.2	38.1	7.0	100.0
	Uncertain*	7.4	16.1	53.5	23.1	100.0
	Total	15.4	27.0	44.2	13.3	100.0
4	In both years	19.6	32.7	38.8	8.9	100.0
	In 1976-77 only	22.2	30.8	38.0	9.0	100.0
	Uncertain*	7.0	21.9	40.9	30.1	100.0
	Total	16.0	29.1	39.3	15.6	100.0
5	In both years	18.3	33.2	40.4	8.2	100.0
	In 1976-77 only	18.5	33.0	40.3	8.2	100.0
	Uncertain*	7.0	19.6	49.5	23.9	100.0
	Total	15.0	29.2	43.0	12.7	100.0
6	In both years	20.5	32.4	41.3	5.8	100.0
	In 1976-77 only	14.9	37.4	36.6	11.1	100.0
	Uncertain*	5.5	17.4	49.5	27.6	100.0
	Total	14.9	28.0	43.5	13.6	100.0

*This group of students received reading CE in 1976-77 according to their school coordinators' reports in the Compensatory Education Roster; but in the Student Background Checklist, their teachers of record indicated that they did not receive CE in that year. Because of the discrepancy between the two sources of data, we were uncertain about their CE-participation history.

**The four levels of cost are defined in terms of the mean and standard deviation (s.d.) of the total standard-resource-dollar costs for reading services received, for all CE students within each grade, as follows: High = one or more s.d. above the mean; High Average = zero to one s.d. above the mean; Low Average = zero to one s.d. below the mean; and Low = one or more s.d. below the mean.



Note. — Students who received CE in 1976-77 according to records in the Compensatory Education Roster, but whose teachers did not identify them as participants in that year were classified into the group having 'uncertain' CE-participation pattern.

Figure 5-4

Average Math Scores at Pretest for Math CE Students by Participation Pattern During the 1975-76 and 1976-77 School Years

Table 5-4

Percentage of Math CE Students Receiving Services at Four Levels of Effort, by Participation History

Grade	CE-Participation in 1975-77 School Years	Levels of Cost for Math Services**				Total
		High	High Average	Low Average	Low	
1	In both years	13.2	38.4	43.1	5.3	100.0
	In 1976-77 only	18.3	34.1	41.5	6.1	100.0
	Uncertain*	7.8	23.2	52.2	16.8	100.0
	Total	11.3	29.8	47.5	11.4	100.0
2	In both years	17.9	35.0	39.1	7.9	100.0
	In 1976-77 only	27.0	28.8	42.9	1.3	100.0
	Uncertain*	8.2	22.1	56.9	12.7	100.0
	Total	13.9	27.0	49.5	9.6	100.0
3	In both years	19.3	31.2	43.2	6.3	100.0
	In 1976-77 only	30.5	30.9	34.4	4.2	100.0
	Uncertain*	4.6	20.6	57.9	16.9	100.0
	Total	14.6	26.4	48.3	10.7	100.0
4	In both years	21.3	32.0	43.8	2.9	100.0
	In 1976-77 only	14.9	28.2	53.0	4.0	100.0
	Uncertain*	5.5	18.5	61.8	14.2	100.0
	Total	13.3	25.4	53.1	8.1	100.0
5	In both years	20.0	27.1	47.3	5.7	100.0
	In 1976-77 only	17.0	34.8	43.3	4.9	100.0
	Uncertain*	5.2	24.4	55.5	14.9	100.0
	Total	13.3	27.3	50.0	9.4	100.0
6	In both years	22.2	24.6	49.7	3.4	100.0
	In 1976-77 only	21.4	33.8	41.6	3.2	100.0
	Uncertain*	6.0	17.0	63.6	13.3	100.0
	Total	14.3	21.9	55.6	8.2	100.0

*This group of students received math CE in 1976-77 according to their school coordinators' reports in the Compensatory Education Roster; but in the Student Background Checklist, their teachers of record indicated that they did not receive CE in that year. Because of the discrepancy between the two sources of data, we were uncertain about their CE-participation history.

**The four levels of cost are defined in terms of the mean and standard deviation (s.d.) of the total standard-resource-dollar costs for math services received, for all CE students within each grade, as follows: High = one or more s.d. above the mean; High Average = zero to one s.d. above the mean; Low Average = zero to one s.d. below the mean; and Low = one or more s.d. below the mean.

Regarding the relationship between receipt of services and achievement status, we find from Table E-7 evidence that shows a practice of increasing services for the lower-achieving students. This finding is parallel to that in reading.

The distributions of services over each group of math CE students are described in Table 5-4. The data show that few of the misidentified participants (about 5 to 8 percent) receive services at the high cost level, while more than 70 percent of them receive services at levels below the average cost for all CE students. In comparison with the misidentified participants, the repeated and new participants generally receive more services; but the two groups do not differ substantially with respect to the distribution of services, and their differences are inconsistent across grades.

Conclusion. In both reading and math, the misidentified participants tend to achieve better at the pretest and receive less services than the participants who are unambiguously identified. The repeated participants on the average have slightly lower pretest scores than the new participants; and the two groups also differ insubstantially with respect to receipt of services. Disregarding their histories of participation, CE students who receive more services during the year are typically lower-achieving at the beginning of that year.

Taking these findings together, we believe that there is a tendency to allocate services according to need. History of participation, however, does not seem to make a large difference in service allocation. In general, CE students who achieve better relative to their CE peers are likely to be misidentified as non-participants by their teachers; and, in addition to receiving less services, it is possible that they could also miss other special treatments. This last comment could have relevant implications for CE policy (e.g., should the teachers be informed of their students' CE status), although it is not of primary interest here.

Achievement Growth in Relation to History of CE Participation

In this section, achievement gains are compared among the groups of CE students having different participation patterns in order to examine how repetition of CE participation in a successive year can affect achievement. Our aim is to assess the relative validities of three hypotheses concerning the effects of continued CE services: the incremental effects, the diminishing effects, and the independent effects. The detailed results of the analyses are given in Appendix E. Here, we will discuss the findings for reading and math separately.

The Effects of Repeated Participation in Reading CE. The results of the ANOVA with type of services as the cofactor and those of the ANCOVA with three service composites as covariates (the first and the second methods of adjustment for instructional differences; see the section on Evaluation Design) are presented in Table E-8, while the results of the ANOVA with level of efforts as the cofactor (the third method of adjustment) are presented in Table E-9. In each table, data are summarized with respect to three indexes of achievement growth.

Before we examine the main effects of the CE-participation factor, it is necessary to determine whether these effects vary with the characteristics of the instructional services received. This question can be answered by the tests of the interaction between the CE participation and the service factors in the ANOVAs, and by the tests of parallel regression surfaces in the ANCOVA. With rare exceptions, these statistical tests are generally insignificant (at the .01 level) regardless of the indexes of growth used and the methods of analysis employed. We conclude that the effects of CE-participation history do not differ as the type, intensity, and/or amount of services vary.

Hence, the issue of the effects of participation history can be addressed primarily by studying the adjusted main effects of the CE-participation factor (that is, adjusted for instructional differences) in the ANOVAS, and by comparing the adjusted group means in the ANCOVA. The results based on each of these methods are similar. Furthermore, the adjusted and the observed group means generally exhibit the same patterns of the differences between the repeated and the new participants. However, the results appear to differ occasionally when different indexes of growth are analyzed.

Table 5-5 presents the observed mean gains for CE students who participated in both 1975-76 and 1976-77 school years (repeated participants), who participated only in 1976-77 (new participants), and whose participation in 1976-77 are not certain (misidentified participants). Examining the mean differences, we find that typically the misidentified participants have the smallest means among the groups. As this group always achieves higher pretest scores than the other groups, their smaller gains may be partially attributed to regression artifacts; however, the differences are frequently too substantial to be ignored completely. We suspect that the misidentified participants do not gain as much because their teachers, being unaware of their CE status, may inadvertently fail to provide all the additional help intended for them.

The statistical tests in Tables E-8 and E-9 consistently reveal significant differences among the groups at grades 1 and 3. At grade 3, the difference lies primarily between the misidentified participants and the other participants; the differences between the repeated and new participants are comparatively small, though the repeated participants appear to do slightly better. Because the repeated participants at this grade have slightly lower pretest means, this small difference could be spurious, a case of the regression-toward-the-mean phenomenon. We are therefore cautious about considering this finding as evidence for incremental effects.

On the other hand, at grade 1, the repeated participants gain substantially more than the new ones, when residual gains are analyzed. This result suggests that repetition of CE at this grade may enhance the immediate effects, and gives support to the hypothesis of incremental effects.

Turning to grade 2, we observe an opposite direction of the differences: new participants appear to gain slightly more than the repeaters, but these differences are statistically insignificant at the .01 level. Considering the large sample sizes, this result gives little support to the hypothesis of diminishing effects. Nevertheless, it is interesting to note that the Compensatory Reading Study (Trismen et al., 1975) also found that at grade 2, CE students who had received services before might benefit less from the immediate services than those who had no such prior exposure. We are not certain how this coincidence can be explained, particularly because it happens to be different from the findings at other grades.

At grades 4, 5, and 6, differences among the groups are either insignificant or inconsistent across indexes of growth. The results for grades 4 and 6 in the Compensatory Reading Study were also not clear-cut. We think that the situation is undoubtedly more complicated at later grades because more school years have elapsed and there are many more ways in which the pattern of participation over the years can vary among students. For this reason, it would be difficult to sort out the effects of continued participation unless the students' school experiences are followed for a long period.

On the whole, we are disturbed that the findings vary with grades, and sometimes differ for different gain scores. The inconsistent results among indexes of growth pose another problem concerning the appropriate measure for assessing the effects. We consider the present analysis inconclusive with regard to the nature of the effects of repeated participation in reading CE.

The Effects of Repeated Participation in Math CE. Parallel to Tables E-8 and E-9, we present the results of the math analyses in Tables E-10 and E-11. The statistical tests on interactions and parallel regressions are consistently significant (at the .01 level) at grades 2 and 4 when instructional services are measured by numbers of hours (see Table E-10). In addition, there are also occasional significances at grades 1 and 3 in these respects. The significant test results suggest that the effects of the CE-participation factor may vary with types or amounts of services. On the other hand, when instructional services are represented by levels of effort (see Table E-11), there are no significant interactions between the CE-participation and service factors except at grade 1. As the F-ratios in all of the significant cases are small relative to the large samples in the analyses, we regard these findings as weak evidence for differential effects of repeated CE participation according to instructional services. Therefore, we will focus our discussion on the overall effects of the CE-participation factor.

Table 5-5

Average Achievement Gains in Reading for CE Students by Participation Patterns During the 1975-76 and 1976-77 School Years*

Grade	Index of Gain**	CE Participation in 1975-77 School Years		
		In Both Years	In 1976-77 Only	Uncertain*
1	Z-Score Gain	0.02	0.06	-0.10
	Residual Gain A	11.12	7.59	-4.77
	Residual Gain B	14.88	2.76	-7.90
2	Z-Score Gain	0.05	0.09	0.01
	Residual Gain A	-1.72	1.90	0.18
	Residual Gain B	-3.13	4.97	-1.60
3	Z-Score Gain	0.08	0.06	-0.01
	Residual Gain A	0.37	-0.53	-6.82
	Residual Gain B	2.66	2.19	-6.14
4	Z-Score Gain	0.02	0.03	-0.00
	Residual Gain A	-0.43	0.15	-3.52
	Residual Gain B	4.49	-2.66	-3.77
5	Z-Score Gain	0.02	0.05	-0.03
	Residual Gain A	20.43	2.51	-3.19
	Residual Gain B	-0.46	4.56	-2.53
6	Z-Score Gain	0.04	0.06	-0.02
	Residual Gain A	-4.99	-2.96	-4.26
	Residual Gain B	7.68	3.96	-2.25

*Sample sizes can be found in Table E-4 of Appendix E. Students who received reading CE in 1976-77 according to our records in the Compensatory Education Roster, but their teachers did not identify them as participants in that year were classified into the gorup having 'uncertain' CE-participation pattern.

**Z-score gain is obtained by transforming the percentile scores into standard-normal-deviate scores. Residual gain A is obtained as observed posttest vertical-scale score minus that predicted by the regression model developed based on data for non-CE students attending non-CE schools. Residual Gain B is obtained similarly, but the regression model is based on data for non-CE students attending CE schools. In both models, posttest scores are predicted from pretest scores and selected student-background characteristics. (See Appendix B5 for more explanation.)

Note. — The sample includes only CE students for whom there are data for all the variables required in the analysis (test scores, background characteristics, and CE-participation records for the two years).

Again, the results with the three methods of analysis are mostly in agreement. We first note that when the Z-score gains are analyzed, the statistical tests on the effects of participation history are insignificant at all grades. This result suggests that with respect to improvement of percentile ranks, the hypothesis of independent effects is correct. However, this hypothesis is not supported universally when other indexes of the effects are examined.

The analyses of residual gain scores show that after adjusting for instructional effects, the main effects of the CE-participation factor are significant (at the .01 level) at grades 1, 3, 5, and 6. These significances are consistent among the methods of analysis and between the two kinds of residual gains. Note also that at these grades, there are few interactions between the service and participation factors.

Because the adjusted and the observed group means reveal the same patterns of differences among the groups, we present only the observed means in Table 5-6. In terms of residual gains, we again find from Table 5-6 that at grades 1, 3, 5, and 6, the misidentified participants generally have the lowest mean gains, raising the same concern that they may have been overlooked in the provision of CE services.

Concerning the effects of repeated participation, the data for grades 1, 3, and 6 indicate that the repeated participants usually attain substantially larger gains than the new participants. These results support the hypothesis of incremental effects when CE participation continues in a successive year. By contrast, the means at grade 5 reveal an opposite result: the mean gain of the new participants is considerably higher than that of the repeaters, a finding that supports the hypothesis of diminishing effects.

Finally, the general results at grades 2 and 4 indicate that history of participation does not noticeably affect the immediate achievement growth of CE students. Thus, the hypothesis of independent effects is supported at these two grades. Incidentally, we remark that, although insignificant, the new participants show a larger average gain than the repeaters at grade 2, a result reminiscent of that in reading.

In summary, we find three different possibilities when math CE services are continued in a subsequent year: the effects are incremental at grades 1, 3, and 6, diminishing at grade 5, and not influenced by previous experience at grades 2 and 4.

The different results at different grades prevent us from making a uniform recommendation on the policy of continuing CE services for low-achieving students. We suspect that the different findings among grades may be artifactual, reflecting mostly the curricular differences and the different characteristics of the achievement tests at different grades. Specifically, we think that introduction of new concepts and skills, such as set theory and fractions, into the curriculum and the achievement tests at grade 5 may explain the unique finding there. It is possible that the instructional contents for the repeated and the new participants are different at this grade because of their differences with respect to readiness for the new skills.

For instance, the new participants may only need help in the new skills and therefore the teachers concentrate on assisting them to master those skills which are measured in the tests. On the other hand, the repeaters may still be behind in the basic skills taught at earlier grades. Because the mastery of these basic skills is required in order to learn the new ones effectively, the supplementary services for the repeaters are concentrated on instruction of the old skills rather than on direct instruction of the new skills. As a result, the accelerated achievement of the new participants can be demonstrated with a test that emphasizes the new skills, whereas such a test would be insensitive to the improvement made by the repeaters during that year. This phenomenon may explain the lower mean gains of the repeaters at grade 5. However, we do not have pertinent data (such as the differential contents of instruction for the two groups of students) to verify this conjecture.

Table 5-6

Average Achievement Gains in Math for CE Students by Participation Patterns During the 1975-76 and 1976-77 School Years*

Grade	Index of Gain**	CE Participation in 1975-77 School Years		
		In Both Years	In 1976-77 Only	Uncertain*
1	Z-Score Gain	0.15	0.05	-0.05
	Residual Gain A	18.41	6.85	1.31
	Residual Gain B	11.47	1.35	-4.10
2	Z-Score Gain	-0.01	0.00	-0.01
	Residual Gain A	1.48	3.26	0.43
	Residual Gain B	-7.82	7.33	-2.94
3	Z-Score Gain	0.09	0.13	0.00
	Residual Gain A	23.64	7.74	-4.10
	Residual Gain B	-3.18	0.15	-7.95
4	Z-Score Gain	0.02	0.06	-0.06
	Residual Gain A	-1.29	2.40	-4.89
	Residual Gain B	-8.42	-6.61	-5.98
5	Z-Score Gain	0.07	0.16	0.00
	Residual Gain A	4.34	13.86	-0.12
	Residual Gain B	2.32	12.37	-3.24
6	Z-Score Gain	0.10	0.04	-0.00
	Residual Gain A	11.71	7.35	-1.89
	Residual Gain B	16.02	0.61	-3.72

[*] Sample sizes can be found in Table E-6 of Appendix E. Students who received math CE in 1976-77 according to our records in the Compensatory Education Roster, but their teachers did not identify them as participants in that year were classified into the group having 'uncertain' CE-participation pattern.

[**] Z-score gain is obtained by transforming the percentile scores into standard-normal-deviate scores. Residual Gain A is obtained as observed posttest vertical-scale score minus that predicted by the regression model developed based on data for non-CE students attending non-CE schools. Residual Gain B is obtained similarly, but the regression model is based on data for non-CE students attending CE schools. In both models, posttest scores are predicted from pretest scores and selected student-background characteristics. (See Appendix B5 for more explanation.)

Note. — The sample includes only CE students for whom there are data for all the variables required in the analysis (test scores, background characteristics, and CE-participation records for the two years).

Conclusion. In general, the effects of repeated CE participation do not vary with the characteristics of instructional services. In both reading and math, our data for grades 1 and 3 tend to support the hypothesis of incremental effects of continued CE services. At other grades, the findings differ between reading and math. In math, the hypothesis of incremental effects is also supported by the data for grade 6, while the data for grade 5 support the opposite hypothesis, the hypothesis of diminishing effects. In the remaining cases, there is little evidence that the immediate effects of CE vary with students' participation history either in reading or math; that is, the hypothesis of independent effects is supported. We do not have sufficient data to explore further why the results are different at different stages of schooling, but we raise a conjecture that the differences may be artifactually related to the characteristics of achievement tests and curricula.

Although the results are similar regardless of the analysis methods employed, they sometimes differ between indexes of growth. Thus, we are concerned about the appropriate measure of the effects under investigation. Certainly different indexes could have different meanings and therefore would give different results. But then which one is the most meaningful (or most important)? Due to the limitation of the single-year data, we leave further explorations to future analysis. We hope that when the educational experiences of the students are traced for more years, a clearer picture will emerge.

SUMMARY AND CONCLUSIONS

Two important issues on effective allocation of CE services are addressed with the first-year data from the Sustaining Effects Study. The first issue concerns the best time for providing CE services, that is, whether CE services are more beneficial at an earlier or later stage of schooling. Based on the cross-sectional data, this question is answered by examining the differential effects of CE at elementary grades. The evaluation results in Chapter 2 are summarized in terms of four indexes: vertical-scale-score gain as a percentage of the gain associated with the 50th percentile rank of the national norm, observed posttest score as percentages of *two* kinds of expectations, and change of percentile score from pretest to posttest. These indexes of achievement for CE students are compared among grades with reference to their differences from the respective indexes for the educationally needy non-CE students. The conclusions from these comparisons are recapitulated below.

- For both reading and math, the effects of CE are relatively larger at the earlier grades. The relative effects at different grades, however, do not reflect their relative CE efforts. In light of these results, we think that CE can more efficiently improve the achievement of its participants at the earlier grades when learning problems are remedied in time.

- The differential effects of CE by grades are more pronounced in reading than in math. The positive effects of reading CE are primarily noticeable at the first three grades; and not detectable at grades 4 and 5. For math, the positive effects are more or less detectable at all grades, but particularly substantial at grades 1 and 3.

- The positive effects of both reading and math are evident mostly for the programs that receive all or partial support from Title I funds. The programs that receive funds exclusively from non-Title I sources infrequently demonstrate beneficial effects on the achievement of their participants.

The second issue deals with the effects of continued CE participation. Because student participation history is traced back only one year, the investigation is confined to testing three simple hypotheses on how participation in a preceding year may influence the effects of current CE services. The hypotheses are: (1) *incremental effects* (the immediate effects of current CE are enhanced by previous participation); (2) *diminishing effects* (the immediate effects are reduced when participation is repeated); (3) *independent effects* (the immediate effects are not influenced by history of participation). It must be emphasized that our interest is *not* in the accumulation of CE effects over years, but in the immediate effects of the services provided during the year. The cumulative effects cannot be properly determined with achievement data in a single year, and will be studied in subsequent reports.

The relative validities of the three alternative hypotheses are assessed by comparing the achievement growth (during 1976-77) of two groups of CE students: those who participated in both 1976-77 and 1975-76, and those who participated only in 1976-77. The conclusions of our analyses are as follows:

- Both in reading and in math, there is little evidence for interaction between instructional services and history of CE participation with regard to their effects on achievement growth. That is, the effects of repeated CE participation do not vary noticeably with the characteristics of the instructional services provided.

- The data appear to support different hypotheses depending on the grades and subject areas. At grades 1 and 3, the hypothesis of incremental effects is supported, for both reading and math CE. In addition, the incremental effect of math CE also receives support from the data for grade 6. The math data for grade 5, however, support the opposite hypothesis of diminishing effects. In other cases, there is little evidence that the immediate effects of CE are influenced by previous participation. Thus, the analysis is inconclusive regarding the nature of the effects of continued CE participation. Until there is further clarification of the issue by the longitudinal analysis, we would recommend, on the basis of the present findings, the policy of continuing CE services to the needy students.

- As a byproduct of our analysis, we find that CE students who are not so identified by their teachers tend to receive less services; after adjusting for instructional differences, they still make smaller improvement in achievement than the CE students who are correctly identified. This result raises a suspicion that the misidentified CE students (who tend to achieve higher pretest scores relative to their other CE peers) may benefit less from CE because they may have missed some of the special treatments.

In conclusion, the cross-sectional analysis confirms the intuitive belief that earlier CE is likely to have greater impact. On the other hand, the analysis reveals some complicated relationships between participation history and the effects of CE. In order to use the limited CE resources effectively and to design programs that can efficiently serve the long-term CE participants, it is important that we understand the long-term effects of CE. In this respect, the nature of the effects of continued CE-service and their possible interactions with the kinds of services provided require ample attention in the future analysis.

PART II

THE RELATIONSHIPS BETWEEN THE EDUCATIONAL PROCESS AND EDUCATIONAL DEVELOPMENT

INTRODUCTION TO PART II

In Part I of this report, interest is focused on the effects of compensatory services. In this second part, we shift the concern to the general relationships between academic development and education.

First, the overall effects of instructional time and four operational dimensions of education (characteristics of instructional personnel, school environment, teacher's practices, and class organization) are considered in Chapter 6. Both the independent effects of each educational variable and the combined effects of the variables are assessed in order to further our understanding of the mechanism underlying the complex relations between the educational process and student development. The aim is to increase our knowledge of what constitutes an effective program for improving achievement. Although a few useful findings are obtained, the results of the analysis generally do not reveal strong evidence of the effects of variables that have long been considered important (e.g., the individualization of instruction).

Despite the discouraging results of Chapter 6, we continue the search for ways to improve the design of programs by a different but complementary approach. In Chapter 7, we employ the technique of discriminant analysis to determine the educational factors that are useful in distinguishing between programs for students achieving high and low growth. The idea is that the educational variables having substantial effects are expected to produce the differences between the achievement of students. Therefore, the results of the discriminant analysis can be used to verify the findings in the previous chapter. Furthermore, the alternative way of analyzing the data may help discover other effective educational methods that may have been overlooked by the regression analysis because it assumes a uniform, linear relationship between the variable and achievement for the entire range of the achievement scores. Although a clear picture still does not emerge from the discriminant analysis, it provides additional information on what methods may improve the effectiveness of education.

Finally, as the effects of education may be dependent on student characteristics, the earlier analysis without consideration of the interaction effects between the educational process and student background may obscure the findings. To refine our analysis, such interaction effects are explored in Chapter 8. However, the consideration of the interactions again does not make the results clearer than what has been learned in earlier chapters.

The general conclusion from all these analyses is that there are few stable, consistent, and pronounced relationships between the various educational aspects and academic development Where differences are revealed among grades with regard to these relationships, the differences mostly do not have systematic patterns and are not obviously interpretable. Nevertheless, combining the evidence obtained with the different analyses, our results suggest that a general picture of relatively more effective programs may be as follows:

- more time for regular instruction by classroom teachers;
- instruction by more experienced teachers;
- giving feedback to students concerning their progress more frequently;
- reducing physical fights, violence, and other disruptive behavior of students that cause disturbances of instruction.

In addition, among the school's existing conditions, it is found that high concentration of low-achieving students in the school is generally unfavorable to student progress. It might be that schools with larger proportion of low-achieving students usually have greater educational burdens. More assistance to these schools to upgrade their programs is therefore needed. In this regard, it is encouraging to see the recent recommendation in the legislation to consider school's educational need (assessed in terms of number or proportion of educationally deprived children in the school) as an additional criterion for determining the eligibility of the school to receive Title I funds.

The lack of important and meaningful findings in the second part of this report could in part be attributable to the short period of the schooling examined. We hope that subsequent analyses of the multi-year data will reveal a better picture regarding how to design effective programs.

CHAPTER 6. EDUCATIONAL DEVELOPMENT AND THE PROCESS OF EDUCATION

The role of education in the academic development of students is examined in terms of five major dimensions. In addition to instructional time which has been investigated in previous chapters, four operational and contextual aspects of the educational process that are not related to time are also considered: qualifications and attitudes of teachers, school environment, teacher's practices in the classroom, and school's policy of organizing classes. Exploratory analyses are performed to determine the factors that have either direct or indirect effects on achievement. The effects of each dimension are assessed first by its marginal influence that is the resultant of the direct relation to achievement and the indirect relations because it covaries with other dimensions affecting achievement. Then, the partial effects attributable to the direct relation alone are estimated by statistically controlling for the other dimensions. The marginal and the partial effects of the five dimensions are considered together in order to understand the relationships between education and achievement.

The school-year analyses reveal few systematic relations between achievement growth and the educational process as described by the data for this study. Similar to the findings in previous chapters where the marginal effects of instructional time are assessed without controlling for other educational aspects, the negligible impacts of the amount of special instruction are reconfirmed. However, there is again evidence that amount of regular instruction has a positive but modest effect. Among other dimensions, only instructional personnel and school environment appear to have been measured by variables that are consistently related to student's progress. Experience of the teachers, as reflected in years of teaching, is the only characteristic of teachers to demonstrate substantial, positive effects on both reading and math achievement. With regard to environment, high concentration of low-achieving students in the school, suggesting its likely disadvantages both in learning climate and in the burden of educating deprived children, can hamper the academic progress of its students; such negative effects are consistently evident in math.

Unable to support the effects of various educational methods, teacher practices in particular, the results of this chapter are not very helpful to the design of effective programs. The distal measures of the educational dimensions and the short period of schooling examined are probably the reasons for such discouraging results.

In the preceding chapters, we have found some evidence that compensatory programs have helped Title I students in improving their achievement. However, there are generally no strong relationships between amount of instruction and achievement growth. In particular, there is little evidence that amount of special instruction, which distinguishes between the services received by CE and non-CE students, has positive impacts on achievement. Thus, we remain concerned about the aspects of educational process that effect improvement. In addition to instructional services, we now expand our attention to other dimensions of education that may be effective in promoting achievement. It is possible that teacher behaviors in the classroom (e.g., how they interact with the students and how they structure their instruction) have greater influence on learning than the amount of different kinds of instruction.

The Sustaining Effects Study has obtained general information on the educational experiences of elementary students in a national sample of schools, by the methods of questionnaire survey. The data include characteristics of teachers, their practices in the classroom, and other school conditions and policies that may affect learning. In this chapter, we examine the data collected during the 1976-77 school year to begin our inquiry into the relations between the educational process and achievement. The purpose is to obtain from the first-year data useful information to guide later analyses of the multi-year data. The analyses in this chapter are intended to be exploratory. This choice is based on the consideration that this report covers only eight months of the development process, and the educational dimensions are measured only once during this period. Because of these constraints, the data do not afford the formulation of an adequate model to describe the causal relations among the educational and achievement factors.

To achieve the ultimate objective of determining the important factors in the achievement process, the three-year data will be analyzed with structural-relation models in a later report (Report 15). In addition, the substudy of Successful Practices in High-Poverty Schools has gathered in-depth data on the educational process in a subsample of 55 schools by means of classroom observations and teacher interviews. These data have been collected for the 1978-79 school year and are analyzed in Report 16. The results of these analyses can complement those obtained in the longitudinal study that includes a larger sample but has less penetrating data. By coordinating the analyses from these interrelated reports, we hope to find an accurate picture of the effective programs that can be adopted by schools to better the achievement of their students.

The results of the analysis in this chapter do not reveal much useful information regarding what program characteristics are particularly effective in promoting achievement. Specifically, the effectiveness of individualization and strong leadership of the principal, which are both believed to be important features of successful programs, receive little support from the analysis. These results may be discouraging but need not rule out the possibility of finding other effective practices. It is likely that the variables investigated fail to show substantial effects on achievement because the achievement process being examined is too short or because they do not represent relevant information. Nevertheless, the general belief that experienced teachers are more effective than inexperienced ones does receive confirmation from the data.

Additionally, the relationships between the development of student attitudes and some of the educational dimensions (personnel, environment, and practices) are also examined. However, there are few noteworthy findings from such analyses, most likely a consequence of the questionable validity and reliability of the student affect measure.

THE DATA AND ANALYSES STRATEGY

For the present analysis, the educational-process variables are divided into two major sets. The first set of variables measures the amount of exposure to learning activities by time, and has been studied earlier. The second set describes the operational and contextual aspects of the educational process: the staff who deliver the instruction; the environment in which the program is implemented; teacher practices in the classrooms and methods of instruction; and school policy of organizing classes for instruction. Thus, five dimensions of the process are considered (time, personnel, environment, practices, and organization); each is believed to have an effect on learning. We are interested not only in how each of these dimensions is related to achievement progress but also in the combined influence of the dimensions.

The Combination of Data for Students, Teachers, and Schools

As explained in previous chapters, the time dimension is measured for each student on the basis of the student participation and attendance record (see Chapters 1 and 3). However, the educational environment and organization of classes are described for each school in general, while primary descriptions of instructional personnel and educational practices are obtained for each teacher. The school- and teacher-level measures are absorbed into the data for individual students by means of student-teacher and student-school linkages.

During the first year of this study, all students having usable achievement data remain in the same school so that the mapping of the school data to the student data is a very simple matter. On the other hand, because there are frequently multiple teachers who provide instruction to a student, the translation from teachers' data to their students' data requires some averaging. The teacher linkages provide up to three teachers' names for each student in each subject, but do not show the proportions of time each student is instructed by each teacher. Consequently, the simple average of the data from multiple teachers is taken as an approximate measure for the student. Since only a small percentage of students have three teachers on record (see Report 9), the student data are based on either one or two teachers.

For an individual student, the data on teacher practices may not be accurate not only because of the aforementioned strategy of averaging over teachers but also because teachers' typical responses to the questionnaire items need not apply to each of their students equally. We expect teachers to vary their practices among students, but such detailed responses for each student are deemed impossible to obtain in a study of this large scope. Of further concern is that many important educational variables such as the daily interactions between the student and the teacher and the actual content of instruction are necessarily left out in the analysis because classes are not actually observed. As a result, the analysis model could suffer substantial specification error.

Sometimes to make up for the omissions of these variables, dummy-coded variables for teachers or classes are introduced into the model to account for the relations attributable to the unmeasured teacher or class-level variables. This strategy, however, often results in findings that lack substantive interpretation. As an alternative, aggregates of student-level variables (such as pretest scores and background characteristics) may be incorporated into the model to allow examinations of both the between-teacher and within-teacher relations simultaneously. This is the strategy commonly recommended in multi-level analysis, and can be similarly applied to examine the between-school and within-school relations in the same model. The aggregate measures are interpreted as proxies of substantive aspects of the classes or the schools (e.g., peer characteristics reflecting interactions among students, economic background of the school suggesting possible level of resources, and racial composition in the school indicating school climate).

Because school aggregates are easy to obtain and because class aggregates are frequently similar within a school, the second strategy is followed by adding several school aggregates to the model. These aggregates at the school level are summarily interpreted as components of the school-environment dimension in this chapter. Thus, the general model of the analysis contains not only student, teacher, and school-level measures by virtue of the levels of data collection, but also school-level variables that are compositional or contextual. In sum, the analysis centers on student-level outcomes but uses mixed-level independent variables. It allows descriptions of the relationships between individual achievement and educational dimensions which function through the instructional personnel as well as school context.

Analytic Approaches

Having explained how the different elements of the data are to be used in the analysis, we now turn to address the analysis procedures. Although it is desirable to study causal relations between the educational process and achievement by means of structural-relation modeling, such an approach would be fruitful only if both the development of students and the process of schooling are followed over an extended period of time. Particularly important, proper examination of the interrelationships among the educational factors and their effects on achievement requires measuring these factors at different times.

Because the within-school-year data provide only one measure for each educational variable during the period, it is difficult to determine whether the relationships between two variables are directionally causal or are simply reflections of their sharing similar causal relations with other variables. However, as the measures of the educational process are obtained for the school period between pretest and posttest administrations, it is reasonable to assume that they are determinants of posttest achievement. With these considerations, we believe that as an initial inquiry, it is appropriate to adopt a multiple regression approach which does not impose explicit causal connections between independent variables.

Despite the long history of educational research, it is generally acknowledged that simple, reliable, and valid measures of the educational dimensions are still difficult to devise. The common practice under the circumstance is to employ multiple data items that are thought to manifest the concept of interest. This strategy, however, has a tendency of resulting in numerous variables for each concept; many of them are either superficial or redundant and do not contain useful information for the construct they purport to represent. As the educational process under investigation is complex and little known, we are inevitably trapped in this situation, especially when the data are collected via a questionnaire survey.

Although we have carefully selected the variables for this study based on conceptual clarity and knowledge gleaned from earlier studies, there remains a large number of variables to be considered. If all of these variables are used indiscriminately, the analysis would require uneconomical computations. Furthermore, confusion would abound when we attempt to interpret the voluminous but possibly trivial results. For this reason, it is important to screen trivial variables from those that can actually contribute to the understanding of the achievement process. To accomplish the screening, the analysis is conducted in two phases. In the first phase, an appropriate model with reduced number of variables is developed on the basis of a 15 percent random sample of the first-year data. The selected model is then employed in the second phase to analyze the data from the whole sample.

Phase One Analysis. The analysis initially concentrates on the selection from among all the variables measuring the same dimension. The joint relationships of the within-dimension variables with achievement growth are examined while variables for other dimensions are ignored. Obviously such a separate analysis of each dimension introduces specification error whenever one or more of the variables from the dimension under consideration are related to some variables for the other dimensions. That is, the independent effect of each variable is confounded with the indirect effects that are results of its covariations with variables for other dimensions. Because the variables for different dimensions are only moderately correlated, we do not anticipate the separate analysis of variables within each dimension to distort their relationships with achievement significantly. Unless the omitted dimensions in each analysis have substantial influences on achievement and are influenced substantially and differently by the variables under examination, these initial analyses should result in proper selections of within-dimension variables that have non-negligible effects on achievement.

In fact, when the different dimensions are appreciably interrelated, it would be helpful to consider both the separate analysis within a dimension and the joint analysis of all dimensions in determining the variables that are worth considering in the final analysis. In this way, the marginal effects of each variable resulting from its unique relationship with achievement and the additional relationships attributable to its interrelations with other independent variables affecting achievement can be taken into consideration when we assess its role in the achievement process. As an example, if a variable has little independent effect on achievement but it causes changes on other variables that have substantial effects on achievement, then it should also be regarded as having an appreciable role. The resultant of the direct and indirect (because of relations with other achievement-related dimensions) effects of a variable is estimated in the within-dimension analysis.

Of course, our major interest is in the variables that play an important role directly. For this reason, the variables that are selected based on the within-dimension screening are combined to form a new model. The new model is used to make the final selection of variables for the four dimensions that are not time-related. The time dimension is not considered in this further step because, on *a priori* grounds, this dimension is treated differently (see later discussion in this section).

This further screening of the variables is designed to select educational factors based on simultaneous considerations of the within- and between-dimension relations among them. For convenience of reference, we differentiate between two models in the phase one analysis: The *submodel* deals with the relationship between each dimension of education and achievement growth, whereas the *full-model* examines the relationships between the four 'time-independent' dimensions and achievement in terms of the variables retained in the submodel screening. If the marginal effect of a variable (as estimated from the submodel) reflects primarily its indirect effects as a result of its influences on variables measuring other dimensions, the partial effect of this variable (as estimated from the full-model) would be small. In this case, unless its marginal effect is strong, it could be eliminated from the final analyses without much loss of information.

As remarked earlier, the analysis of the time dimension in phase one does not follow completely the strategy taken for other dimensions. Because instructional time is an indispensable factor of the educational process, the preliminary analysis is not intended to delete any component of this dimension. Rather, the analysis is aimed at determining the best way to form a small number of composites from the original ten items in the student participation and attendance record. The items that share similar relationships with achievement can be combined to reduce the number of variables and increase the efficiency in the estimation of the regression coefficients.

As the time dimension is measured by differentiating ten instructional arrangements on the basis of type of instructor and size of instructional group, it is reasonable to consider forming the composites by the categories of these two major elements of instruction. Examination of the effects of the composites so defined also provides answers to the popular questions concerning what kind of instructor or what group size is more effective than others. A third possibility of forming the composites is to combine the components that best distinguish between the instruction received by CE and non-CE students. This method has been used in earlier chapters and will be compared with the preceding two methods in order to choose one of the three sets of composites for use in the phase two analysis.

In both the submodel and full-model analyses, a step-wise procedure is employed to screen the variables on the basis of their contributions to the explanation of achievement variation. The procedure sequentially selects variables into the regression model for predicting posttest achievement by considering their effects after adjusting for the effects of variables that have already been selected at preceding steps. Thus, the first variable selected has the largest total effect; the second variable selected has the largest effect after partialling out the effect of the first variable, etc. In this way, a variable is selected either because it has large marginal effect or because it has large partial effect after other variables have been selected. In order not to overlook any variables that have potential effects on achievement, a lenient criterion (F for the significance of the regression coefficient is greater than 2.0) is adopted for including the variables in the selected model.

Phase Two Analysis. In the second phase, only the variables that are judged to have potential effects on achievement during the phase one screening are included in the analysis. These selected variables are analyzed with the multiple regression method using the whole sample of the first-year data. The interest now centers on the direct effect of each variable and how all the five dimensions of the educational process jointly affect achievement progress.

Problems of the Multiple-Regression Approach. In the multiple-regression analysis, the interrelations between variables are assumed to be mutual and non-directional. The primary loss of this approach is that the exact path of how an educational factor exerts its influence on achievement cannot be revealed. However, as many of the interrelations between the educational variables in our data base are theoretically ambiguous, we doubt that their causal relations can be properly described with stringent models.

For instance, although it is reasonable to think that the experience of a teacher can affect his/her practices but not vice versa, the reality could be that they do not have direct relations but they are correlated merely because of their common link to other variables. One possibility could be that teacher experience and practices are correlated only because schools that encourage certain practices also tend to retain teachers of particular experiences. Unless we have detailed information from the schools concerning their policies and/or we follow the changes of teacher practices across years, we can not have a clear picture of this kind of relationship. Considering the complexity of the interrelations among educational variables and the absence of important and relevant information needed to resolve such relations, we suggest that the regression analysis is a useful step toward understanding the achievement process as it is related to education.

Another problem in the multiple-regression analysis is that if the independent variables are highly correlated, the estimation of the regression coefficients can be quite unstable (having large standard errors). For this reason, in the presentation of the detailed results of the analyses in phase one, the proportion of the variance of an independent variable that is unexplained by other variables that have already been in the model is indicated in the table for each educational variable. This proportion is commonly known as the tolerance of the variable (and is equal to one minus the multiple R^2 between that variable and the variables entered prior to it). With the exception of the aggregate variables, the educational variables have very high tolerances, suggesting that collinearity is not a serious problem. Indeed, the intercorrelations among these variables are generally low (of magnitude smaller than .20).

Adjusting for the Effects of Background Factors. Because initial achievement and student characteristics have substantial relationships with later achievement, these background factors are always controlled for when we examine the effects of education on achievement. Thus, in all of the phase one and phase two analyses described above, the model always includes the pretest score and certain student characteristics (e.g., race/ethnicity, economic status as indexed by participation in meal-programs) that prove to have substantial influence on achievement.

In phase one, a hierarchical regression strategy is employed to select first the student characteristics; and then in the presence of pretest score and these student characteristics, the effects of the educational variables are assessed to determine whether to include them in the model. In technical terms, the step-wise procedure assigns highest priority of entry to pretest score, second priority to student characteristics, and considers last the entry of the educational variables. In phase two, the model analyzes simultaneously the pretest score, student characteristics selected in phase one, and the educational variables determined to have meaningful effects on achievement.

EXPLORATORY ANALYSIS OF THE EFFECTS OF EDUCATIONAL PROCESS ON ACHIEVEMENT

The analyses in phase one (using a 15 percent random sample of the data) serve two purposes: to select nontrivial variables for further analysis in phase two and to study the marginal effect of each educational dimension separately. As a reminder to the reader, the marginal effect of a dimension is the resultant of its direct influence (which the dimension exerts independently on the outcome) and its indirect influences (which it exerts via other achievement-related dimensions). For instructional services, the differential effects of amounts of instruction by type of instructor and by size of group are discussed. For the other four dimensions that are not time related, each dimension is considered alone first, and then the four are jointly examined in order to select a subset from their component variables to represent the characteristics of the educational process in the phase two analysis.

The effects of education are assessed with a regression model that describes the posttest achievement as a linear function of the pretest achievement, student characteristics, and the educational variables. The posttest and pretest achievements are measured by the scores attained on the SDC-recommended level of the Comprehensive Test of Basic Skills (CTBS, see Chapter 1). Four student characteristics that are shown to be predictive of achievement growth in Chapter 2 are employed as potential background variables: need for compensatory services as judged by teachers, educational attainment of the mother, participation in the free or reduced-price meal programs (an index for family economic status), and white/minority status. Some of these background variables may be omitted if they prove to have negligible contributions during the step-wise selection process. The educational variables will be described in the following sections when their effects are discussed.

The Marginal Effects of Learning Time by Kind of Instruction

The amount of time each student spent in learning activities is estimated from the first-year data for each of the ten instructional arrangements listed in the Student Participation and Attendance Record. In this section, the ten components of the total instructional time are analyzed in three parallel ways: by the type of instructor involved, by the size of group in which the instruction is received, and by the instructional setting as defined earlier (see Chapter 3) in terms of the component's ability to differentiate the receipts of services between CE and non-CE students.

The ways of combining the ten components into appropriate composites for the three sets of analyses are illustrated in Figure 6-1. The results of these analyses are not independent of one another because the composites simply represent different groupings of the same data. The reason for these interdependent analyses is to address the questions regarding the effects of different types of instructor and different sizes of instructional group. At the same time, the results provide some empirical bases for choosing a particular set of composites to be used in subsequent analyses. The set of composites that is most meaningful and can jointly explain most of the achievement variations will be selected to represent the time dimension of the educational process in the analysis of phase two.

In terms of the type of instructor involved, four composites of learning time are formed: time spent with classroom teachers, special teachers, other personnel (aides, assistants, or tutors), and in independent seat work (without instructor). If type of instructor is a more critical element of instruction, with respect to its effects on achievement, then these four service composites would be more likely to have differential effects than other sets of composites. In this case, the analysis using this set of composites would also be expected to result in a larger multiple correlation than when other sets are used.

The second way of examining the effects of learning time is focused on the size of instructional group. Three different sizes are considered: large group (consisting of 14 or more students), medium group (approximately 7 to 13 students in the group), and small group (approximately 1 to 6 students). Again, if group size is the more important element of instruction, then the analysis based on this set of composites would be more productive (revealing greater differential effects and a larger multiple correlation).

The last method of categorizing the data for instructional time is by instructional setting. Three settings are identified on the basis of the different emphases on instruction between compensatory and regular programs: regular instruction (by classroom teachers and in medium or large groups), special instruction (by special teachers, aides or in small groups), and tutor/independent work (work with tutors or with study materials independently). This set of composites has been used in Part I of this report because of the special interest in the effects of compensatory education there.

The detailed results of the three parallel analyses for reading and math are presented in Appendix F (Tables F-1 to F-6, one table for each grade). Of particular interest in these tables are the partial correlations between each service composite and posttest achievement. The partial correlations are traced throughout the analysis steps as each background factor is added to adjust for its confounding effect on achievement. These data can help us understand the role of student backgrounds in the relationships between achievement and instruction, particularly with regard to the difficulty in showing a positive effect of the amount of special instruction.

By studying the pattern of these partial correlations, we can obtain a clear picture of how the pretest achievement and background variables affect the receipt of services and the posttest achievement concurrently. Specifically, amounts of instruction by special teachers, in small groups, or in a special setting all have negligible effects on achievement. However, because more of these kinds of instruction is given to low-achieving students who are likely to come from disadvantaged families (poor, minority, or having less educated mothers), they can appear to have negative impacts on achievement if the background factors are not adequately controlled. Frequently, adjusting for the pretest differences alone is not sufficient to explain away the negative correlation between posttest achievement and amount of special instruction. Although further adjustment for the background differences typically reduces the negative correlation to trivial, none of the adjustments has been able to produce a positive partial correlation. Thus, it is reasonable to conclude that amount of special instruction has little impact on achievement.

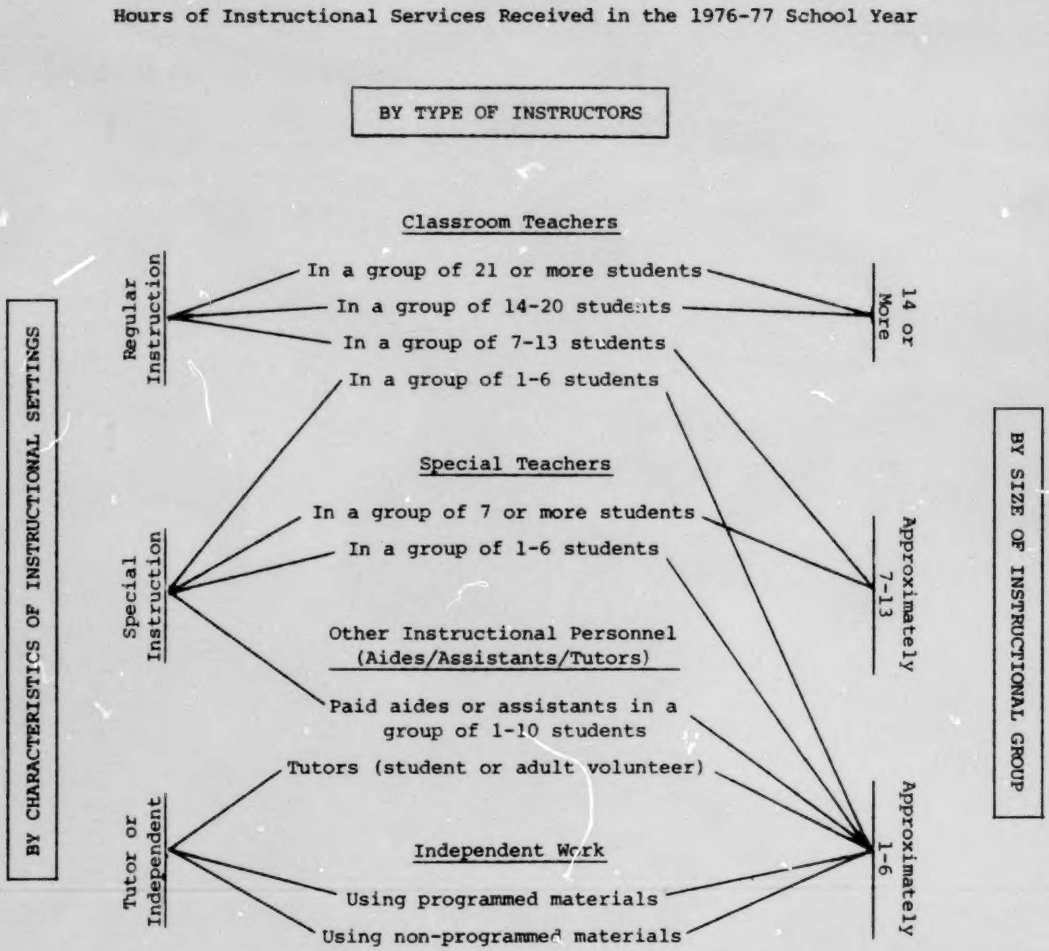

Hours of Instructional Services Received in the 1976-77 School Year
BY TYPE OF INSTRUCTORS
BY CHARACTERISTICS OF INSTRUCTIONAL SETTINGS
BY SIZE OF INSTRUCTIONAL GROUP
Classroom Teachers
In a group of 21 or more students
In a group of 14-20 students
In a group of 7-13 students
In a group of 1-6 students
Special Teachers
In a group of 7 or more students
In a group of 1-6 students
Other Instructional Personnel (Aides/Assistants/Tutors)
Paid aides or assistants in a group of 1-10 students
Tutors (student or adult volunteer)
Independent Work
Using programmed materials
Using non-programmed materials
Regular Instruction
Special Instruction
Tutor or Independent
14 or More
Approximately 7-13
Approximately 1-6

Figure 6-1

Descriptions of the Three Sets of Composite Variables for Reading/Math Services, Obtained on the Basis of Hours of Instruction Received in Ten Different Instructor/Grouping Combinations

For easy reference in our discussion, the results presented in Appendix F are summarized in Table 6-1. In what follows, we will examine the differential effects of instructional time by type of instructor, by size of instructional group, and by instructional setting. The results of these three ways of examining the effects of instructional time will be compared to decide which set of composites to use in phase two of our analysis.

The Effects of Time by Type of Instructor. On the whole, the effects of learning time are small regardless of the type of instructor used. Only in math does the analysis consistently indicate a small, positive relationship between the amount of instruction by classroom teachers and achievement progress at four of the six grades (grades 2 through 5). Evidence of positive effects of instructional time is sparse for the four types of instructors in reading. In reading, amount of time spent with special teachers shows negative effects at grades 3 and 6. Because reading instruction by special teachers is mostly provided to low-achieving students as compensatory services, especially at grade 3 and above (see Report 5 and Chapter 3), such negative effects are likely mere reflections of the inadequately controlled differences between the students who receive different amounts of this kind of instruction.

The Effects of Time by Size of Instructional Group. There are few appreciable effects of learning time on reading achievement. In reading, differentiation of time by group size in which instruction is delivered does not increase the chance of detecting the effects of time. However, amount of time in large-group and small-group instruction has some modest but positive effects on math achievement. This result in math is related to the finding obtained in terms of type of instructor, as large-group instruction is always provided by classroom teachers (a constraint of the data collection in this study) while small-group instruction mostly represents either independent work or instruction by classroom teachers.

The Effects of Time by Instructional Setting. When instructional time is categorized in terms of settings that distinguish between the services received by CE and non-CE students, amounts of special instruction and tutor/independent work generally have negligible effects on achievement. On the other hand, more time in regular instruction improves achievement growth, especially in math. This result suggests that increase of time in regular instruction is more likely to help raise the achievement of students than use of special teachers or reduction of group size.

As the length of a school day is limited, increasing the intensity of instruction may be a preferred form of compensatory services because it avoids keeping the students in school for extra hours or missing other activities. However, neither use of special teachers nor reduction of group size guarantees an improvement of the intensity or quality of services unless it is accompanied by changes in instructional style and method (such as increased attention to individual students). By comparison, increase of instructional time expands the opportunity for the students to learn, which can be particularly important for the educationally deprived children who often lack such opportunity outside the school. In line with this argument, additional time of instruction for low-achieving students is to be encouraged. Nevertheless, the reader should not be misled into thinking that instructional time alone will foster achievement growth. Although there is evidence of the positive effect of time, in math particularly, the effect is small.

Selection of the Time Composites for Later Analyses. Considering the results of the analyses for both reading and math, we find that the three sets of composites for instructional time do not differ greatly with respect to their contributions to the explanation of achievement differences among students. The squared multiple correlations resulting from the regression analyses are practically the same regardless of which set of the composites is used. The findings concerning the relationships between instructional time and achievement growth are similar among the analyses and show no obvious conflicting implications.

In terms of the effects of each composite, 14 of the 48 regression coefficients (29 percent) in the analyses by type of instructor meet the criterion of having an F-ratio greater than 2.0. (The 48

Table 6-1

Summary Results From Preliminary Examination of the Effects of Amounts of Instruction on Achievement by Type of Instructor, By Size of Instructional Group, and by Instructional Setting

Variables Describing Amount and Kind of Instruction		Relation to Achievement Growth in Grade*					
		1	2	3	4	5	6
By Type of Instructor							
Classroom Teachers	R:	+	·	·	·	·	·
	M:	·	+	+	+	+	·
Special Teachers	R:	·	·	-	·	·	-
	M:	-	·	+	+	·	·
Aides/Assistants/Tutors	R:	·	·	·	·	·	·
	M:	·	·	·	·	·	·
Independent Seat Work	R:	·	·	·	·	+	+
	M:	·	·	+	+	·	·
By Size of Instructional Group							
Large Group (14 or more students)	R:	·	·	·	·	·	·
	M:	·	+	+	+	+	·
Medium Group (Approximately 7-13)	R:	+	+	-	·	·	·
	M:	·	·	·	+	·	·
Small Group (Approximately 1-6)	R:	·	·	·	·	·	·
	M:	·	·	+	+	+	·
By Instructional Setting							
Regular Instruction	R:	+	+	-	·	·	·
	M:	+	+	+	+	+	·
Special Instruction	R:	·	·	-	·	·	·
	M:	·	·	·	+	·	·
Tutor/Independent Work	R:	·	·	·	·	+	+
	M:	·	·	+	·	·	·

*The effects of amount of instruction on Reading (R) and Math (M) achievement are examined separately, after controlling for background differences among students. Type of instructor, size of instructional group, and instructional setting represent three different ways to distinguish the kinds of instruction. The relation of amount of instruction to achievement growth is assessed in terms of the partial regression coefficient presented in Tables F-1 to F-6 of Appendix F:

'+' indicates that amount of the particular kind of instruction has an effect on achievement growth that is positive and meets the criterion of F greater than 2.0 for inclusion in the prediction equation for posttest achievement.

'-' indicates that the effect is negative and meets the inclusion criterion.

'·' indicates that the effect is negligible in that it does not meet the inclusion criterion.

coefficients are obtained from 12 analyses — six grades in reading and math, each having four coefficients representing the four types of instructors.) By size of instructional group, 11 of the 36 coefficients (31%) meet the criterion, while 13 of the 36 coefficients (36%) in the analyses by instructional setting do so.

On the basis of its relatively greater chances to yield noticeable contributions to the prediction of achievement growth, the set of composites by instructional setting is selected to represent the time dimension in later analyses that examine the effects of instructional time jointly with other dimensions of the educational process. This set of composites also has greater capability to differentiate between CE and non-CE students in terms of their receipts of services (see Report 5).

Conclusions of the Marginal Effects of Time. Judging from the results of preliminary examination, the amounts of time in different kinds of instruction are not likely to be very critical in explaining achievement growth. Increasing the time of regular instruction by classroom teachers will slightly better the achievement. But in order to overcome the academic deficit of compensatory-education students in this way, more additional instruction would be required than is practical or affordable.

In general, amount of instruction has greater effects on achievement in math than in reading. This result is congruent with the previous finding of greater effects of compensatory services in math. In reading, time is positively related to achievement progress only at the first two grades. A similar finding was also obtained in studies by Guthrie and his colleagues (Guthrie, Samuels, Martuza, Seifert, Tyler, and Edwall, 1976), and by Coles et al. (1976). The lack of evidence for positive time-effects in the upper grades is probably attributable to the greater emphasis on providing more instruction to lower-achieving students in these grades (see discussion in Chapter 3). This phenomenon also helps explain why the effects of compensatory reading services are negligible or relatively smaller at the higher grades. It can be argued that if amounts of time for different kinds of instruction do not affect achievement appreciably, then providing more instruction to compensatory-education students could not be expected to raise their achievement status.

Although Wiley and Harnischfeger (1974) have made a strong case for the importance of instructional time in improving achievement, their opinion receives only weak support from the school-year analysis. Most recently, Cooley and Leinhardt (1978) also found that amount of time had little relationship with either achievement gain or achievement level. It is likely that the immediate effects of learning time are small, but the long-term effects can be substantial. If so, the final judgment on the effects of time awaits the longitudinal analysis. A further comment is that perhaps time has small or negligible effects on achievement in these studies because it is not measured accurately. In particular, one expects time to be important only if it is spent in relevant learning. Thus, observation in the class to record the actual time for learning instead of the scheduled time may improve the chances of detecting large time-effects.

The Marginal Effects of Educational Dimensions That Are Not Time-Related

In addition to time, the educational programs are also described in this study by their operational and contextual characteristics. Four such dimensions are examined here: instructional personnel, school environment, teacher practices, and organization of classes. These dimensions are measured by variables that are not dependent on amount of instruction. The component measures of each dimension are explained below when the effects of the particular dimension are discussed. We first examine the effects of each dimension separately and then look into the interrelations among them.

Characteristics of Instructional Personnel and Achievement Growth. A continuously recurring hypothesis regarding what makes a difference in academic achievement is that the critical factors lie in the people who deliver the instruction. Aside from the fact that instructors are the most direct agents of educational services, this hypothesis has a great appeal when one thinks of the great teachers of great people, such as Aristotle and Anne Sullivan.

Teacher's quality is generally believed to be the important factor of effective teaching. In particular, many educators have advocated that the ability of the teacher determines how well his/her students progress academically (e.g., Mood, personal correspondence to SDC). It is, however, difficult to measure the ability of teachers, particularly in a survey study. As substitutes, teacher's qualifications such as attainment of academic degrees, training, and teaching experience have been regularly included in studies of teaching effectiveness and the effects of schooling (e.g., Peck and Tucker, 1973; Summers and Wolfe, 1977).

For the present analysis, five variables are defined on the basis of teacher self-report to describe the quality and attitude of the teachers of each student. Additionally, two school-level variables are used to characterize the contacts between students and school staff: staff-to-student ratio and support-to-teaching personnel ratio. These two variables are thought to have influences on the quality of interaction between instructional staff and students. In sum, seven variables are employed to represent the dimension of instructional personnel. Table 6-2 explains how these variables are obtained from the first-year data and indicates references to Report 9 where detailed descriptions of the variables can be found.

The simple correlations between these variables and posttest achievement are presented in Table F-7 of Appendix F. (Correlations of posttest score with the four student characteristics and the variables for other dimensions of education are also provided in this table.) Among the seven variables dealing with instructional personnel, only teacher experience (as indexed by years of teaching) consistently shows a positive correlation with the posttest score, followed closely by teacher attitude to school programs (as reflected in his/her subjective feelings of the success and effectiveness of the programs). In both cases, the correlations are small; less than .15 in general. A teacher's education (measured by the highest degree earned), amount of in-service training received in recent years, and the ratio of number of staff in the school to total enrollment all correlate negatively with posttest achievement. Such negative correlations are almost consistent across grades and subjects; but most of them are insubstantial. The other two variables (the teacher's belief in schooling as a cause of achievement and the ratio of number of support staff to number of teaching personnel) has essentially negligible correlations with posttest score.

Detailed results of the submodel analysis for this dimension are presented in Table F-8 of Appendix F. The analysis employs a stepwise-regression procedure to assess the effects of the seven variables representing the characteristics of instructional personnel, with adjustment for pretest and background differences among students but ignoring their differences in other educational dimensions. The significant variables selected in the submodel analysis are further analyzed with the full-model to determine their partial effects that are independent of their relationships with other dimensions. The results of this full-model analysis are given in Table F-12 for reading and F-13 for math. A summary of the results from both the submodel and the full-model analyses is provided in Table 6-2 for quick reference.

Examination of the summary results in Table 6-2 reveals that experience of the teacher is positively related to achievement growth at nearly all grades and in both reading and math. This positive relationship exists regardless of whether the effects of other dimensions are controlled for or not. The consistency of this finding gives us some assurance that the positive effect of teacher experience on student achievement, although small, is meaningful and not fortuitous. However, it should be noted that the finding is at odds with the result of a recent study in Philadelphia (Federal Reserve Bank of Philadelphia, 1979), which finds no positive relationship between teacher experience and student achievement progress. Hanushek (1970) also found no statistically significant relationship in this regard, whereas Summers and Wolfe (1977) concluded from their study that there was an interaction effect between teacher experience and student achievement level. The latter study suggested that students who achieved below grade level tended to do better when instructed by less experienced teachers, but those who achieved above grade level progressed more when instructed by more experienced teachers.

One may be concerned that the results of the present study could be merely a consequence of the choice of a generous criterion for judging the effects. This concern is alleviated by the fact that similar findings are obtained in the phase two analysis where a more stringent criterion (significance

Table 6-2

Variables Describing Characteristics of Instructional Personnel and Their Status in the Hierarchical Regression Analysis

Variable	Item Content and Interpretation	Reference to Report 9		Preliminary Screening for Inclusion in the Final Analysis for Grade*					
				1	2	3	4	5	6
Staff/student ratio (School-level)	Number of school staff divided by student enrollment	Chapter 8, Table 8-27	R:			▲			
			M:			△			
Support/Teaching Personnel ratio (School-level)	Number of support staff (e.g., librarians, counselors) divided by number of teaching staff (e.g., teachers, aides, assistants)	Chapter 8, Table 8-27	R:	△					▼
			M:					▲	▼
Years of Teaching	Number of years as full-time teacher in any school	Chapter 5, Table 5-1	R:	▲	▲	▲	▲	▲	
			M;	▲	▲	△	▲	▲	▲
Highest Degree Earned	1 = Less than BA; 2 = BA; 3 = MA or Equivalent; 4 = Ph.D	Chapter 5, Table 5-3	R:			▲			
			M:					△	
Recent Inservice Training	Total Hours of Inservice Training in instruction, received during the last 3 years (1974-77)	Chapter 5, Table 5-5	R:	▲		▽			▲
			M:	▲		▼	▲		
Belief in Schooling	Teacher's rating on the importance of instruction as cause of achievement	Chapter 5, Table 5-8	R:		▽				△
			M:	▲					▼
Attitude to School Programs	Rating on teacher's positive feelings (programs are well planned; student needs are met; instruction is effective; and resources are sufficient)	Chapter 8, Table 8-7	R:	△	▼				
			M:					▲	

*Screening of variables is done for Reading (R) and Math (M) separately and by grades.

▲ - indicating that the variable is retained in the full-model analysis with positive regression coefficient. (A full-model analysis considers the background variables and all variables describing the characteristics of educational process. Results are presented in Tables F-12 and F-13 of Appendix F).

▼ - same as ▲ except that the regression coefficient is negative.

△ - indicating that the variable is retained in the sub-model analysis with positive regression coefficient, but is eliminated in the full-model analysis because of insignificant contribution. (A sub-model analysis considers the background variables and the set of variables included in the present table, while omitting variables describing other aspects of educational process. Results are presented in Table F-8 of Appendix F).

▽ - same as △ except that the regression coefficient is negative.

Blank indicates that the variable is eliminated in the sub-model analysis because of insignificant contribution.

at the .01 level) is used (see later discussion in this chapter). It is therefore reasonable to regard our results as a confirmation of the common belief that experienced teachers are more effective than the inexperienced ones. However, exactly how the experienced teachers help their students improve achievement remains unclear, because we lack the relevant data to investigate how teacher experience can influence the aspects of instruction that are pertinent to learning.

The remaining characteristics of instructional personnel rarely show similar effects among grades or between reading and math. The effects of these variables are significant mostly at only one or two grades. More important, the direction of their effects frequently changes from one grade to another without an interpretable pattern. These results lead us to suspect that the variables are not meaningfully related to achievement growth.

Educational Environment and Achievement Growth. The second dimension primarily deals with contextual characteristics of the educational programs. It includes variables describing the conditions of the school on the basis of the characteristics of its student body; the availability of central facilities that help enrich the learning experience of students; instructional atmosphere with regard to disturbances caused by fights, violence, or other disruptive behaviors of students; participation of teachers, principal, district staff, parents, and community members in the design and implementation of programs; and the administrative structure and testing policy of the school district. All of these elements are expected to exert some influence on student achievement as they collectively set the environment in which students learn by interacting with each other and with the teachers. Just as the work environment in a factory can affect the productivity of workers, the educational climate in the school can be conducive or unfavorable to learning and, thus, influence the achievement of students.

Ideally, a thorough understanding of the role of the educational environment in the achievement process requires examination of how it influences the proximal aspects of instruction such as teacher's conduct in the classroom, the capability of the program to meet the needs of the students, and the daily contacts between students through which they stimulate each other to learn. Without sufficient data to make these connections, we settle for a crude assessment of the remote effects of environment, disregarding the underlying mechanism that actually produces the effects.

The 13 variables belonging to this dimension are explained in Table 6-3, which also provides references to Report 9 where full descriptions of the variables are given. All of the variables are defined at the school level. Four of the variables pertaining to the conditions of the school are obtained from aggregating the characteristics of students in the school: minority concentration, poverty concentration, concentration of CE students, and concentration of low achievers. These compositional variables are interpreted as peer characteristics in some studies (e.g., Summers and Wolfe, 1977). Because they are closely related to the nature of interaction between students and between students and teachers, they are considered to be important factors in the achievement process. Furthermore, they may also give indication of the richness of resources and educational burden of the school.

School's central resources are believed to be helpful to learning because they provide stimulating materials and surroundings. The mobility rate of students affects the stability of the environment for learning. Disturbance of instruction caused by fights and violence may distract the students and teachers, and thus interfere with learning. Active participation of the school and district staff, and parents or community members is expected to improve the quality of instruction and its suitability for the needs of the students. Last, the testing policy and the organizational structure of the district (e.g., district top-heaviness as indexed by the percentage of administrative staff) may also affect the orientation of service delivery and have some effects on achievement.

As noted earlier, the simple correlations between these variables and posttest score are presented in Table F-7 of Appendix F. None of the variables has consistently positive correlations with the posttest, but the four aggregate-variables and disturbance of instruction are negatively and substantially correlated with posttest score at all grades and in both reading and math. Correlations between posttest score and all other variables are generally small.

Table 6-3

Variables Describing Characteristics of Educational Environment and Their Status in the Hierarchical Regression Analysis

Variable	Item Content and Interpretation	Reference to Report 9		Preliminary Screening for Inclusion in the Final Analysis for Grade*					
				1	2	3	4	5	6
School's Minority Concentration	Percent of students in the school who are not white/caucasian	None	R:				▲		△
			M:	△	▲	▲	▲		
School's Poverty Concentration	Percent of students in the school who participate in free or reduced-price meal programs	None	R:						
			M:					▲	▲
School's CE Concentration	Percent of Reading/Math CE students in the school	None	R:	▲	▲				
			M:				▼		
School's Low-Achiever Concentration	Percent of Reading/Math students achieving below the 33rd percentile	None	R:		▼	▼		▽	▼
			M:	▼	▼	▼	▼	▼	
School's Central Resources	1 = presence of reading/math resource center; 0 = absence of such resource center	Chapter 8, Table 8-12	R:	▲					
			M:	▲					
Student Mobility Rate	Percent of students moving from attendance area plus percent of students moving into the area in a school year	Chapter 8, Table 8-27 (Also Table 8-18)	R:						
			M:						
Parent/Community Involvement	A measure of the amount of parent and community involvement in the school's programs; based on items from principal and teacher questionnaires (e.g., participation in decision-making, involvement in program development and evaluation, PTA meeting)	Chapter 8, Table 8-28 (Also Tables 8-19, 8-20)	R:	▼				▲	
			M:		▲	▽	▽	▲	
District Control of Instruction	Degree of control that the district has over the school's programs; based on items from District, Principal and Teacher questionnaires (e.g., participation in decision-making, control of allocation of funds, choice of texts)	Chapter 8, Table 8-28 (Also Chapter 9, Tables 9-3 to 9-7)	R:	▲	▽				
			M:						
Principal's Intructional Leadership	Degree to which the principal provides leadership for the school's programs; based on items from Principal and Teacher questionnaires (e.g., participation in curriculum development, planning and evaluation, observing classrooms, and control of decision-making)	Chapter 8, Table 8-28 (Also Tables 8-1 to 8-7)	R:	▲		▼			
			M:				▼		
Teacher's Involvement in Decision-Making	The degree of involvement teachers have in making decisions related to instructional programs (course content, resource utilization, text selection, program development and evaluation)	Chapter 8, Table 8-28	R:		▽				
			M:		▼			▼	
Disturbance of Instruction	The amount of disturbance to instruction caused by such problems as fights, vandalism, truancy, and other disruptive behavior, based on items from Principal and Teacher questionnaires	Chapter 8, Table 8-28	R:	▲				▼	
			M:					▼	▽
District's Testing Program	1 = have district-wide testing program; 0 = no such program	None	R:						
			M:			▼			
District's Percent of Administrative Staff	The percentage of total district staff that is administrative	Chapter 9, Table 9-1	R:		▼	▲			△
			M:			▲			

*Screening of variables is done for Reading (R) and Math (M) separately and by grades. ▲(▼) indicates that the variable is retained in the full-model analysis with positive (negative) regression coefficient. △(▽) indicates that the variable is retained in the sub-model (but not the full-model) analysis with positive (negative) regression coefficient. Detailed results of screening are presented in Tables F-9, F-12, and F-13 of Appendix F.

The variables representing educational environment are analyzed in two ways, parallel to the submodel and full-model analyses described in the previous section. The results of these analyses are summarized in Table 6-3, while Tables F-9, F-12, and F-13 in Appendix F provide the detailed results from the stepwise procedures. With the exceptions of the four aggregate-variables, the characteristics of educational environment contribute little to the explanation of achievement variations. The regression coefficients of these non-aggregate variables generally meet our inclusion criterion in three or fewer grades and frequently change sign from one grade to another, indicating unstable and therefore not very meaningful relationships between them and achievement growth.

Among the aggregate variables, concentrations of minority students and low-achieving students show consistent relationships with achievement growth in math. In reading, concentration of low-achieving students is negatively related to achievement growth in four of the six grades. Similarly, the relationships between concentration of low-achieving students in the school and the achievement development in math are negative in five of the six grades. On the other hand, concentration of minority students is positively related to math achievement growth in four of the six grades.

However, these results are difficult to interpret because the variables correlate substantially with their corresponding variables at the student-level which are also included in the analyses as control variables. The collinearity between the school aggregate and the respective student-level measure is expected as a result of the non-random distributions of students among the schools (i.e., such distributions are determined by the parents' choices of residential areas which do not follow a random process). Nevertheless, we note that the negative effects of low-achiever concentration were also found in Summers and Wolfe (1977).

In summary, characteristics of educational environment generally do not have systematic relationships with achievement growth. In particular, principal leadership, which was reported to be associated with effective programs in the ESAA in-depth study (Wellisch, MacQueen, Carriere, and Duck, 1977), is found here to bear little or no relationship with achievement growth. Perhaps the variables in this study, which are constructed on the basis of the self-reports of the principals and teachers, do not reflect accurately the pertinent characteristics of leadership or involvement in the programs.

Educational Practices and Achievement Growth. The third dimension is composed of eight variables describing teacher practices in the classroom and in instruction. Teacher practices are regarded as the aspect of education that is closest to the process of learning, and are expected to have direct influences on achievement. These variables are defined in terms of teachers' self-descriptions of what they do in the classes. Each variable is obtained separately for reading and math. Their construction is explained in Table 6-4 while detailed descriptions of them are provided in Report 9 (see Table 6-4 for a guide to the appropriate chapter and tables).

The simple correlations between the eight variables and posttest score are reported in Table F-7 of Appendix F. Almost without exception, these correlations are low and rarely bear the same sign across grades. Even with these low and inconsistent correlations, some potentially meaningful results may still be obtained from the submodel and full-model analyses, as presented in Table F-10. A summary of the results is also given in Table 6-4.

Except for the amount of homework assigned per week, none of the variables representing teacher practices shows significant and consistent relationships with achievement progress in reading at more than two grades. This lack of finding with respect to the effects of education on reading achievement is common regardless of which dimension is examined. Because of the high correlation between pretest and posttest scores in reading, the variables in this survey study are mostly not sensitive enough to reveal substantial effects on achievement. Amount of homework is positively related to growth, but the relationship is weak and significant only at the first two and the sixth grades. It is suggested that in order for the homework to be helpful to achievement, it should be

Table 6-4

Variables Describing Characteristics of Educational Practices and Their Status in the Hierarchical Regression Analysis

Variable	Item Content and Interpretation	Reference to Report 9		Preliminary Screening for Inclusion in the Final Analysis for Grade*					
				1	2	3	4	5	6
Effort in Curriculum Development	Number of hours spent in curriculum development during the 1976-77 school year	Chapter 6, Table 6-5	R:						
			M:	▽				▼	▼
Effort in Planning and Evaluation	Number of hours spent in needs assessment, planning and program evaluation during the 1976-77 school year	Chapter 6, Table 6-5	R:					▲	△
			M:	△					
Teacher's Use of Lesson Plans	1 = lesson plans are used in instruction; 0 = classroom activities dictated by student's interest and expressed need, no lesson plans	Chapter 6, Table 6-5	R:	▲					▲
			M:	▼				▲	▽
Frequency of Feedback per Semester	Number of times the teacher provides feedback (grade, strength, or weakness) to the student in a semester	Chapter 6, Table 6-8	R:						▲
			M:	△	△	▲	▲		▲
Weekly Homework Assigned	Average hours of homework assigned to the student in a week	Chapter 6, Table 6-14	R:	▲	△				▲
			M:	▲	▲	▽	▲		▲
Monthly Use of Materials	Number of times per month the teacher uses materials (e.g., textbooks, reference books, dittos) in instruction	Chapter 5, Table 6-17	R:					▲	
			M:		▲				
Individualization of Instruction	The extent to which the teacher uses individualized approach in instruction (individualization is indicated by differences in aspects of instruction for different students)	Chapter 6, Table 6-18 (invididual items in Tables 6-9 thru 6-13)	R:					▼	
			M:	▽		▼	▼		▲
Monthly Use of Audio-Visual Equipment	Total number of times per month the teacher or student uses Audio-Visual equipment (e.g., TV, projectors, viewers, study carrel) in instruction and learning	Chapter 6, Table 6-18	R:	▲	▼			▼	
			M:			▲			▼

*Screening of variables is done for Reading (R) and Math (M) separately and by grades.

▲ - indicating that the variable is retained in the full-model analysis with positive regression coefficient.

▼ - same as ▲ except that the regression coefficient is negative.

△ - indicating that the variable is retained in the sub-model analysis with positive regression coefficient, but is eliminated in the full-model analysis for lack of contribution.

▽ - same as △ except that the regression coefficient is negative.

Blank indicates that the variable is eliminated in the sub-model analysis for lack of contribution.
Detailed results of the screening are presented in Tables F-10, F-12, and F-13 of Appendix F.

relevant and the student has to work on it faithfully. Thus, studies using a more refined measure of time spent in doing homework may reveal greater effects. Such a conjecture clearly requires verification with future data.

The picture in math is clearer than that in reading. The positive effect of amount of homework on math achievement receives support fairly consistently (in four of the six grades). In addition, the more frequently the teacher provides feedback to the students concerning their progress, the better they perform in math. This positive relationship is shown in five of the six grades. Contrary to expectation, individualization of instruction does not have significant effects on reading achievement, while it shows a negative relation to achievement progress in math at three grades. Similarly, the amount of time teachers spend in curriculum development is also negatively related to math achievement growth.

Although the negative effects of individualization on math achievement are small, the finding is somewhat disturbing. A possible reason may be that the measure of individualization does not properly reflect the features that are helpful to learning. Specifically, individualization is important and useful if it fits the need of the students and the best method for each student is adopted. In this report, the variable representing individualization reflects largely the degree of differences between teacher treatment of low-achieving and regular-achieving students and the use of subgroups in instruction. As such, the variable does not describe the nature of the different treatments and can not differentiate whether individualization is achieved according to student need. Consequently, the actual effects of individualization may not be revealed in the analysis. Further improvement of the variable is required to clarify this issue.

In short, most of the characteristics of educational practices under consideration do not show appreciable impacts on learning, particularly in reading. This finding obviously does not meet our expectation. Nevertheless, the discouraging result agrees with that of Cooley and Leinhardt (1978) who conclude that "the more important consideration is what gets taught rather than how it's taught." We regard such a conclusion as a bit premature, and remain hopeful that when better data are available, effective practices for improving achievement can be discovered.

Organization of Classes and Achievement Growth. The last dimension examined is concerned with the organization of classes for instruction. Only three variables are obtained to represent this dimension. These are described in Table 6-5, which also indicates the appropriate references to Report 9 for the variables.

While the extent of ability grouping indicates how students are tracked for the purpose of class instruction, it does not provide information about whether the resulting classes are homogeneous or not with respect to achievement level. Such information is obtained from an item in the Student Background Checklist which asks the homeroom teacher to rate the achievement level of students in the class. The data are translated into a dichotomous variable showing whether the achievement levels of the students are generally similar or different.

Additionally, because class size has received ample attention in educational research (see, for example, Glass and Smith, 1979), it is also included in this study although the Student Participation and Attendance Record also supplies data regarding the size of groups for instruction. Class size is believed to be important in education because it can affect the amount of interaction each student has with the teachers and also because it is closely related to program expenditures.

The correlations between these three variables and posttest score are mostly small and of inconsistent signs over the grades, as can be seen from the bottom section of Table F-7 in Appendix F. In reading, except for a negligibly negative correlation at grade 1, there is an almost systematic trend for the positive correlations between class size and posttest score to increase with grades; at the upper three grades, the correlation becomes appreciable. The corresponding correlations in math are smaller by comparison.

Table 6-5

Variables Describing Characteristics of Classroom Organization and Their Status in the Hierarchical Regression Analysis

Variable	Item Content and Interpretation	Reference to Report 9		Preliminary Screening for Inclusion in the Final Analysis for Grade *					
				1	2	3	4	5	6
Classroom Achievement Level	Teacher's report on the achievement level of students in the class. 1 = different among students; 0 = similar	Chapter 4, Table 4-7	R:					▲	
			M:		Δ	∇			
Extent of Ability Grouping (School-level)	The degree to which students are grouped or tracked by ability level. The composite is based on principal's and teacher's answers concerning how students are assigned to classes	Chapter 8, Table 8-28	R:						
			M:				▼		
Class Size	Teacher's estimate of number of students in the class (average over all teachers for the student)	Chapter 6, Table 6-3	R:						
			M:		▼	▼			

* Screening of variables is done for Reading (R) and Math (M) separately and by grades.

▲ - indicating that the variable is retained in the full-model analysis with positive regression coefficient.

▼ - same as ▲ except that the regression coefficient is negative.

Δ - indicating that the variable is retained in the sub-model analysis with positive regression coefficient, but is eliminated in the full-model analysis because of insignificant contribution.

∇ - same as Δ except that the regression coefficient is negative.

Blank indicates that the variable is eliminated in the sub-model analysis for lack of contribution.
Detailed results of the screening are presented in Tables F-11, F-12, and F-13 of Appendix F.

The results of the analyses for this dimension are presented in Tables F-11, F-12, and F-13 of Appendix F, and are also summarized in Table 6-5. This table clearly reveals that the variables rarely show non-negligible effects on reading achievement. However, in math, students attending smaller classes tend to progress more at grades 2 and 3. Note that the regression coefficients for class size are *negative*, indicating that smaller class size relates to greater growth.

The reader may recall that the simple correlations between class size and posttest score are slightly positive, implying higher-achieving students tend to be assigned to larger classes. Such positive correlations can in part be explained by use of smaller classes for compensatory-education students than for regular students (see Report 5). However, after adjusting for pretest and background differences, the effects of class size become either negligible or slightly positive in math.

The lack of effects of class size on reading achievement was also noted in a recent study by Shapson and his colleagues (Shapson, Wright, Eason, and Fitzgerald, 1980). They suggest that because instruction is frequently provided in subgroups within class, particularly in reading, class size becomes less important than expected. The results of previous analysis (see Reports 5 and 9) indeed indicate that reading teachers form subgroups for instruction much more frequently than math teachers. For this reason, we suspect that if group size affects learning, it would be more appropriate to examine such effects in terms of the size of instructional groups. In this respect, we note that earlier analysis of the effects of time spent in groups of different sizes does not produce any better results.

Another comment on the effects of class size is that while it is commonly believed that smaller classes would allow the teachers to interact more intensely with the students and therefore be more effective in teaching, this need not happen in reality. The experimental study by Shapson et al. found that although teachers generally felt the benefit of reducing class size, there was little evidence that they actually changed the way they interacted with students, the time they allocated to individual student work, or their instructional styles or methods. Consequently, the study also did not find appreciable improvement in student performance that was attributable to small classes. We think that the class size in this study as reported by the teacher can not be expected to make a difference in student progress unless some changes also take place to make the instruction more effective when clases become smaller.

Over the years, there are numerous studies on the effects of class size. As cited in Summers and Wolfe (1977), Blake (1954) conducted a survey review of research on class size and reported more evidence for the effectiveness of smaller classes than of larger classes, but he also noted many inconclusive results. Most recently, Glass and Smith (1979) performed a meta-analysis of the effects of class size based on the results reported in about 80 studies. They concluded that smaller class size had a dramatic effect on improving academic achievement. While their conclusion is very encouraging and welcomed by the education community, we are very cautious in accepting its face value because the analysis is flawed and the interpretation is misleading. (Perhaps the authors are too anxious to refute the 'disheartening' conclusion of Porwell's Report that smaller classes need not be expected to result in greater academic achievement.)

Despite the claim by Glass and Smith, we believe that our results showing small or no effects of class size are in agreement with many recent studies. For example, Cooley and Leinhardt (1978) in a similar evaluation study reported a lack of consistent relationship between class size and achievement. Summers and Wolfe (1977) found some interaction effects between class size and achievement level. They reported that classes larger than 28 students could have perverse effects on learning for low-achieving students. Additionally, the experimental study of Shapson et al. was also unable to find large effects of class size. On the basis of our analysis and the results of other studies, it is reasonable to conclude that reducing class size sometimes helps improve student performance, in math particularly, but the effects are not as substantial as might be expected.

Interrelations Among the Dimensions. We now compare the results obtained in the submodel and full-model analyses in order to examine the role of the interrelations among the four dimensions of program characteristics in producing their effects on achievement. From Tables 6-2 to 6-5, we find that most of the variables selected with the submodel analyses are retained in the full-model analyses. Furthermore, comparison of the data given in Tables F-8 to F-11 for the submodel analyses with those in Tables F-12 and F-13 for the full-model analyses, reveals that the magnitudes and the directions of the effects for the selected variables in the full-model are very similar to those estimated in the initial submodel analyses. These results suggest that the collinearities between the dimensions are not a serious problem. Indeed, the intercorrelations among the educational variables are generally small, and the tolerance of each variable remains high as other variables are introduced into the model. (The relatively lower tolerances for the aggregate-variables, which describe educational environment, are a result of their correlations with the background variables rather than of their relationships with other educational variables.)

The squared multiple correlations resulting from the submodel and full-model analyses are presented in Table 6-6. As shown in this table, the full-model and each of the four submodels examining the four dimensions separately result in practically identical multiple correlations, especially in the reading analyses. This result suggests not only that each educational dimension has very small unique contribution to the variations of achievement, but also that the interrelations among them play a negligible role in explaining the achievement differences among students.

Additionally, it may be noted that the four aspects of the characteristics of educational process collectively have very modest relationships with achievement growth. The squared correlation between pretest and posttest scores are also given in Table 6-6 to serve as references for judging the amounts of additional contribution to achievement variations by the background and educational variables. The increments in the proportion of posttest variances accounted for by adding the background and educational variables are 7.1, 4.0, 2.8, 0.9, 1.4, and 1.1 percent in reading for grades 1 to 6, respectively. (These values can be obtained by taking the differences between the first two columns in Table 6-6.) The corresponding increments in math are 4.0, 4.0, 7.9, 3.3, 2.2, and 2.1 percent. Further inspection of the increments of R^2 as each of the background variables is introduced in to the model (Tables F-8 to F-11) indicates that these increments are largely attributable to the contribution of background variables. In the next section, we will further examine the joint relationships of the educational variables with achievement growth by analyzing the data from the whole sample.

Conclusion. On the basis of the exploratory analysis, we conclude that the characteristics of educational process as described in this study do not substantially help us understand what influences student achievement growth. This conclusion, while frustrating, is not different from the common situation encountered in studies that address the general issue of the effectiveness of schooling.

THE RELATIONSHIP BETWEEN THE EDUCATIONAL PROCESS AND BASIC-SKILL ACHIEVEMENT

The preceding analyses deal with the educational dimensions in a sequential manner (i.e., examining each dimension separately and then jointly) in order to aid our understanding of how the educational process is related to achievement growth. The analyses use a random sample of only 15 percent of the first-year data and have not considered the instructional time and the operational characteristics of the programs together. On the basis of these preliminary analyses, we can select for futher analysis only those characteristics of the educational process that have potentially meaningful relationships with achievement. The variables so selected constitute the basic model for our phase-two analysis concerning the relationships between education and achievement development.

In essence, the model for the present analysis includes as independent variables the pretest score, the four student characteristics, the three composites of instructional time, and the educational variables that meet the selection criterion at the last step of the phase-one analysis. The educational variables selected to represent the four operational dimensions of education are indicated in Tables 6-2 to 6-5 by darkened triangles (▲or▼). The dependent variable in the model is the posttest score. This model is applied to analyze the entire first-year data in order to validate the results of the earlier

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Table 6-6

Coefficients of Determination (Multiple R2) for the Full-Model and the Four Submodel Regression Analyses to Examine the Effects of Characteristics of Educational Process on Achievement Growth

Grade	Squared Pretest-Posttest Correlation*	Full Model*	Submodels* - Characteristics of			
			Instructional Personnel	Educational Environment	Educational Practices	Classroom Organization
Reading						
1	.438	.509	.490	.498	.488	.481
2	.636	.676	.673	.674	.672	.671
3	.707	.735	.729	.733	.726	.726
4	.769	.778	.777	.777	.776	.776
5	.800	.814	.810	.811	.811	.809
6	.809	.820	.818	.817	.818	.816
Math						
1	.445	.485	.478	.477	.480	.473
2	.525	.565	.555	.553	.551	.548
3	.538	.617	.578	.612	.580	.576
4	.593	.626	.610	.616	.615	.609
5	.655	.677	.668	.674	.667	.664
6	.679	.700	.694	.691	.695	.690

*A full-model considers the four aspects of educational process concurrently to examine their partial effects, while a submodel considers each aspect separately to assess the marginal effects. Detailed results of the full-model analyses are presented in Tables F-12 and F-13 in Appendix F and results of the submodel analyses are presented in Tables F-8 to F-11. The squared correlation between pretest and posttest can be found in Table F-8. All results are based on analyses of the 15 percent random samples.

exploratory analyses regarding the effects of the educational variables. Additionally, commonality analysis of the posttest variance is performed based on this model to assess the role of education in the academic development of students.

The Partial Effects of Program Characteristics on Achievement

The results of the multiple regression analysis with the selected model are presented in Table 6-7 for reading and Table 6-8 for math. For both reading and math, pretest achievement always makes the largest unique contribution to the prediction of posttest achievement, usually followed by teacher judgment of need for compensatory services. By comparison, the unique contributions of the educational variables are all very small.

Table 6-7

Regression of Reading Posttest Score on Pretest Score, Characteristics of Student Background, Instructional Services Received, and Selected Characteristics of Educational Processes (Based on the Entire Sample of the First-Year SES Data Base)

Variables Employed in the Multiple Regression Model for the Prediction of Reading Achievement Posttest Score**	Unique Contribution to Squared Multiple Correlation ($R^2(U)$), and Standardized Regression Coefficient (Beta)*											
	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	$R^2(U)$	Beta	$R^2(U)$	Beta	$R^2(U)$	Beta	$R^2(U)$	Beta	$R^2(U)$	Beta	$R^2(U)$	Beta
Background Variables												
Pretest VSS Score	.189	.522	.247	.662	.255	.716	.335	.787	.373	.817	.384	.838
White/Minority Status	<.001	(-.005)	.001	.039	<.001	(.006)	.001	.042	<.001	.025	<.001	.029
Free Lunch Participation	.001	-.046	.001	-.047	<.001	(-.011)	<.001	-.026	.001	-.042	<.001	-.025
Teacher's Judgment of CE Need	.027	-.203	.008	-.116	.004	-.087	.003	-.076	.002	-.060	.002	-.051
Mother's Educational Attainment	.004	.070	.001	.039	.001	.041	.001	.036	.001	.028	.001	.026
Instructional Services Received												
Regular Instruction	.002	.050	.001	.026	<.001	(-.000)	<.001	(.005)	.001	.029	<.001	(.006)
Special Instruction	<.001	(.017)	<.001	-.022	<.001	-.023	<.001	(-.007)	<.001	(.010)	<.001	(-.002)
Tutor/Independent Work	.001	.031	<.001	(-.006)	<.001	(-.001)	<.001	(.013)	<.001	(.011)	<.001	(.009)
Characteristics of Educational Processes												
Staff/Student Ratio	NA		NA		<.001	(.009)	NA		NA		NA	
Support/Teaching Personnel Ratio	NA		NA		NA		NA		NA		<.001	-.015
Years of Teaching	.003	.053	.003	.056	<.001	(.007)	.001	.024	<.001	.018	NA	
Highest Degree Earned	NA		NA		<.001	.013	NA		NA		NA	
Recent Inservice Training	<.001	(-.006)	NA		NA		NA		NA		<.001	.022
Attitude to School Programs	NA		<.001	(-.000)	NA		NA		NA		NA	
School's Minority Concentration	NA		NA		NA		.001	.036	NA		NA	
School's CE Concentration	.002	.046	.002	.051	NA		NA		NA		NA	
School's Low-Achiever Concentration	NA		.002	-.071	.005	-.100	NA		NA		<.001	-.016
School's Central Resources	<.001	.024	NA		NA		NA		NA		NA	
Parent/Community Involvement	<.001	-.024	NA		NA		NA		<.001	.013	NA	
District Control of Instruction	<.001	(.016)	NA		NA		NA		NA		NA	
Principal's Instructional Leadership	<.001	.022	NA		<.001	-.019	NA		NA		NA	
Disturbance of Instruction	<.001	.024	NA		NA		NA		<.001	-.022	NA	
District's Percent of Administrative Staff	NA		<.001	-.021	<.001	.017	NA		NA		NA	
Effort in Planning and Evaluation	NA		NA		NA		NA		<.001	.017	NA	
Teacher's Use of Lesson Plans	<.001	(.002)	NA		NA		NA		NA		<.001	(.007)
Frequency of Feedback per Semester	NA		NA		NA		NA		NA		<.001	(.004)
Weekly Homework Assigned	.001	.035	NA		NA		NA		NA		<.001	.012
Monthly Use of Materials	NA		NA		NA		NA		<.001	(.005)	NA	
Individualization of Instruction	NA		NA		NA		NA		<.001	-.012	NA	
Monthly Use of Audio-Visual Equipment	<.001	(.009)	<.001	(-.015)	NA		NA		<.001	-.012	NA	
Classroom Achievement Level	NA		NA		NA		NA		<.001	(.006)	NA	
R^2 for the Regression Model	.475		.671		.734		.756		.810		.820	

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[*] Regression coefficients that are not significantly different from zero at the .01 level are enclosed in parentheses.

[**] Only the subset of educational-process variables selected in the preliminary analyses with a 15 percent random sample was employed in the present analyses. NA indicates that the variable is not included in the analysis as a result of the preliminary screening.

Table 6-8

Regression of Math Posttest Score on Pretest Score, Characteristics of Student Background, Instructional Services Received, and Selected Characteristics of Educational Processes (Based on the Entire Sample of the First-Year SES Data Base)

Unique Contribution to Squared Multiple Correlation ($R^2(U)$), and Standardized Regression Coefficient (Beta)*

Variables Employed in the Multiple Regression Model for the Prediction of Math Achievement Posttest Score**	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	R^2 (U)	Beta	R^2 (U)	Beta	R^2 (U)	Beta	R^2 (U)	Beta	R^2 (U)	Beta	R^2 (U)	Beta
Background Variables												
Pretest VSS Score	.238	.567	.270	.611	.220	.564	.292	.685	.315	.701	.391	.753
White/Minority Status	<.001	(-.000)	.002	.069	<.001	(.021)	<.001	(.023)	<.001	(.012)	<.001	.027
Free Lunch Participation	<.001	-.024	<.001	(-.020)	<.001	(-.015)	<.001	(-.010)	.002	-.052	<.001	-.026
Teacher's Judgment of CE Need	.019	-.161	.012	-.126	.011	-.128	.007	-.102	.005	-.086	.004	-.077
Mother's Educational Attainment	.001	.038	.001	.041	.001	.039	.001	.043	<.001	.016	.001	.033
Instructional Services Received												
Regular Instruction	<.001	(-.015)	<.001	(-.005)	<.001	(-.011)	<.001	(.005)	.001	.031	<.001	.018
Special Instruction	<.001	(.012)	<.001	(-.018)	.001	-.026	.001	.042	<.001	(-.001)	<.001	(-.003)
Tutor/Independent Work	.001	.025	<.001	(-.013)	<.001	(.010)	<.001	(.011)	<.001	.019	<.001	(-.005)
Characteristics of Educational Processes												
Support/Teaching Personnel Ratio	NA		NA		NA		NA		<.001	(.003)	.001	-.032
Years of Teaching	<.001	.023	.004	.065	NA		<.001	(.014)	.001	.025	<.001	.016
Recent Inservice Training	<.001	(-.003)	NA		.001	-.027	<.001	(.009)	NA		NA	
Belief in Schooling	.001	.033	NA		NA		NA		NA		<.001	-.019
Attitude to School Programs	NA		NA		NA		NA		<.001	.016	NA	
School's Minority Concentration	NA		.001	.072	.002	.077	.001	.061	NA		NA	
School's Poverty Concentration	NA		NA		NA		NA		.001	.063	<.001	(-.002)
School's CE Concentration	NA		NA		NA		.001	-.034	NA		NA	
School's Low-Achiever Concentration	.001	-.034	.002	-.067	.022	-.237	.003	-.091	.004	-.108	NA	
School's Central Resources	.001	.028	NA		NA		NA		NA		NA	
Parent/Community Involvement	NA		<.001	(.006)	NA		NA		.001	.028	NA	
Principal's Instructional Leadership	NA		NA		NA		<.001	(-.012)	NA		NA	
Teacher's Involvement in Decisions	NA		<.001	(-.007)	NA		NA		<.001	-.017	NA	
Disturbance of Instruction	NA		NA		NA		NA		.001	-.042	NA	
District's Testing Program	NA		NA		<.001	(-.008)	NA		NA		NA	
District's Percent of Administrative Staff	NA		NA		.001	.033	NA		NA		NA	
Effort in Curriculum Development	NA		NA		NA		NA		<.001	(-.001)	<.001	(-.006)
Teacher's Use of Lesson Plans	<.001	(-.006)	NA		NA		NA		<.001	.018	NA	
Frequency of Feedback per Semester	NA		NA		.001	.024	<.001	(.014)	NA		.001	.032
Weekly Homework Assigned	.001	.029	.001	.031	NA		<.001	(.016)	NA		.001	.033
Monthly Use of Materials	NA		.001	.030	NA		NA		NA		NA	
Individualization of Instruction	NA		NA		.002	-.044	.001	-.027	NA		.001	.035
Monthly Use of Audio-Visual Equipment	NA		NA		<.001	(.013)	NA		NA		<.001	(-.012)
Extent of Ability Grouping	NA		NA		NA		<.001	-.017	NA		NA	
Class Size	NA		<.001	(-.009)	<.001	(-.004)	NA		NA		NA	
R^2 for the Regression Model	.465		.538		.592		.630		.666		.685	

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* Regression coefficients that are not significantly different from zero at the .01 level are enclosed in parentheses.

** Only the subset of educational-process variables selected in the preliminary analyses with a 15 percent random sample was employed in the present analyses. NA indicates that the variable is not included in the analysis as a result of the preliminary screening.

Comparing the standardized regression coefficients for the educational variables in Table 6-7 with those in Table F-12 (of Appendix F), it is found that the corresponding coefficients are mostly of same sign and comparable magnitude. This finding in part provides a cross-validation of the model because the analyses reported in these two tables use different samples. (The entire first-year sample is used in the analyses reported in Table 6-7, while the analyses reported in Table F-12 use only a 15 percent random sample from the first-year data.) Furthermore, the two analyses also differ in that the results of Table F-12 are obtained from analyses that omit the time dimension and some non-contributing student characteristics. Thus, the above comparison between the data in these two tables also suggests that there are no serious distortions of the effects of education inferred from the exploratory analyses. This means that the partial effects of the educational variables, adjusting for the differences among students with respect to other educational aspects, remain similar to what we have discussed earlier. For this reason, we will not repeat the results of Table 6-7 here. Similar remarks apply to the findings for math when the results reported in Table 6-8 and F-13 (see Appendix F) are compared.

With regard to the effects of instructional time, there are few new findings in these final analyses. Generally, only the amount of regular instruction shows positive effects on achievement. Because the effects of time have been extensively discussed in previous chapters and in the earlier section, we will not reiterate the findings in Tables 6-7 and 6-8.

In summary, the latest analyses with data for the whole sample and with the selected model reconfirm our earlier conclusions that there are few systematic and substantial effects of the educational process. Amount of instruction does not prove to be very critical in explaining the achievement differences among students. Among the program characteristics, only the experience of teachers is consistently shown to have a positive relationship with achievement growth. The results presented in Tables 6-7 and 6-8 will be reviewed further in Chapter 7 with an emphasis on the similarities and dissimilarities among grades.

The Role of the Educational Process in Achievement Growth

In order to assess the joint relationship between the educational dimensions and achievement growth, the posttest variance explainable by the model is partitioned into components that are unique to sets of background and educational variables and that are shared by combinations of these sets. The independent variables in the model are divided into three sets for this purpose:

- *Set A: Pretest and Background Variables.* This set contains the pretest score and the four student characteristics (judged need for compensatory services, mother's education, family economic status, and white minority status).

- *Set B: Instructional Services.* This set is composed of the three composites measuring the amounts of time spent in regular instruction, special instruction, and tutor/independent work.

- *Set C: Educational Process.* This set consists of the variables representing the four dimensions of education that describe the program characteristics and are not time related.

The results of the commonality analyses are summarized in Table 6-9. The contribution unique to Set A is always much larger than that for any other set or that shared by any combination of sets. The total contributions of pretest and background variables (obtained by adding up the components that include Set A) by grade are: .46, .66, .73, .75, .81, and .82 for reading; and .46, .53, .56, .62, .66, and .68 for math.

The proportion of posttest variance that is uniquely accounted for by sources other than pretest and student characteristics can be obtained by subtracting the total contribution of Set A from the squared multiple correlation for the model (given in the last line of each section in Table 6-9). These contributions are remarkably small, almost always less than 1 percent. However, there are appreciable contributions that are shared between the educational variables, and the pretest and

Table 6-9

Partition of the Posttest Score Variance Accounted for by Pretest Score and Student Background Characteristics (A), Instructional Services Received (B), and Characteristics of Educational Processes (C)*

Components of Variance A = Pretest and Background B = Instructional Services C = Educational Processes	Grade	Proportion of Posttest Score Variance Accounted for by the Disjoint Components of Variance 1	2	3	4	5	6
Reading Achievement	N	10,746	10,372	10,771	10,672	10,559	11,649
Unique to A**		.4045 (5)	.4214 (5)	.4208 (5)	.5629 (5)	.6434 (5)	.5628 (5)
Unique to B**		.0024 (3)	.0015 (3)	.0003 (3)	.0002 (3)	.0005 (3)	.0001 (3)
Unique to C**		.0080 (11)	.0068 (6)	.0063 (6)	.0011 (2)	.0014 (8)	.0009 (6)
Shared by A and B But Not C		.0283	.0616	.0743	.0966	.0650	.0486
Shared by A and C But Not B		.0179	.1597	.1776	.0652	.0541	.1485
Shared by B and C But Not A		.0005	.0002	.0001	.0000	.0001	.0001
Shared by A, B, and C		.0133	.0201	.0548	.0298	.0458	.0592
Squared Multiple Correlation		.4749	.6713	.7342	.7558	.8103	.8202
Math Achievement	N	10,605	9,965	10,117	9,483	11,016	11,500
Unique to A**		.3676 (5)	.3881 (5)	.3457 (5)	.4532 (5)	.4667 (5)	.5597 (5)
Unique to B**		.0011 (3)	.0004 (3)	.0008 (3)	.0015 (3)	.0009 (3)	.0004 (3)
Unique to C**		.0038 (7)	.0089 (8)	.0297 (9)	.0074 (10)	.0094 (10)	.0042 (9)
Shared by A and B But Not C		.0110	.0115	.0132	.0115	.0228	.0231
Shared by A and C But Not B		.0644	.1096	.1532	.1356	.1396	.0744
Shared by B and C But Not A		-.0004	.0002	.0027	-.0005	.0002	.0001
Shared by A, B, and C		.0176	.0190	.0468	.0212	.0263	.0232
Squared Multiple Correlation		.4651	.5377	.5921	.6299	.6659	.6851

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[*] The analyses used the whole sample of the first year (1976-77 school year). Cases with missing values for any of the variables involved were excluded. The pretest score, yearly hours of instructional services received, and characteristics of educational processes are subject-specific measures with the exceptions of some school-level variables. The student background variables are common for reading and math except for teacher's judgment of CE need. The educational-process variables employed in the analyses for reading and math are listed in Tables 6-7 and 6-8, respectively.

[**] The number in parentheses indicates the number of predictors contained in the variable set.

background variables. These results suggest that the educational process does not independently explain the achievement differences among students, but may have some influence on achievement growth that is not separable from its relationships with student backgrounds.

On the basis of these results, we conclude that the educational process assumes a rather modest role in achievement development. The differences in the educational experiences of the students with respect to the characteristics considered in this study are not important in explaining the differences in their achievement progress. This could suggest that the relevant aspects of education are not validly represented in the analysis. At the same time, it could also suggest that the existing programs are just not sufficiently different from one another so as to make notable differences in the outcome.

THE INFLUENCE OF INSTRUCTIONAL STAFF, ENVIRONMENT, AND PRACTICES ON STUDENT ATTITUDE

Aside from achievement in basic skills, another important aspect of educational development concerns the attitudes of students toward learning and school. Although educators tend to believe that student attitudes can affect their learning, it is equally plausible that how well the students do can affect their feelings about learning and their liking of school. Furthermore, how well the students do in school and how they feel about schooling can both be influenced by their educational experiences. Thus, it is of interest to study how student attitude, achievement, and educational experiences interrelate with one another.

Previous analysis revealed that the correlation between achievement and student attitude as measured by the Student Affective Measure (SAM) was negative and small (see Report 9). The student affect score was found to have low reliabilities, and there was a concern that students, minorities and low achievers in particular, might be inclined to give socially desirable responses to the items in the SAM and consequently the validity of the measure might be questionable (see Reports 5 and 9). Additionally, there are also concerns that many items in the test appear to have ambiguous interpretations and that the presentation of the response alternatives might encourage positive responses. With these considerations, we do not expect the analysis of the student affect scores to produce clear results. Indeed, the analysis in Chapter 2 did not find any meaningful effects of compensatory services on student attitude. The changes of attitude during the school year, for the most part, appears to be trivial. For these reasons, we decided not to expend much effort in the examination of the relationships between attitude and achievement. However, exploratory analyses are performed to provide information on how the educational process might be related to the development of attitude.

Among the five dimensions of education studied in basic-skill development, three are considered to have possible influences on student attitude: instructional personnel, educational environment, and teacher practices in the class. These three dimensions could affect the contacts among students and the interaction between teachers and students so that they would also be related to how students like school and learning. The analysis strategy used in the phase-one analysis of the relationships between basic-skill achievement and education is adopted for the present investigation. However, because separate analyses of the three dimensions produced no noteworthy findings, it was decided not to proceed to the joint analyses of them.

The total student affect score is used as the only measure of attitude because the intercorrelations among the three subscales are very high, relative to their reliabilities (see Report 9). The educational variables for both the reading and math programs are used together to represent each of the three dimensions. These variables were explained previously in Tables 6-2 to 6-4. As there are few meaningful findings from these analyses, their results are presented in Appendix F.

The simple correlations between the posttest score, student characteristics, and the educational variables and the posttest score are given in Table F-14. These correlations are generally small. Among the educational variables, only the concentrations of minority, poor, and low-achieving students show substantial correlations with the posttest score of SAM.

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None of the three educational dimensions is found to have consistent and appreciable relationships with the change of student attitude. Most of the significant findings appear fortuitous and are difficult to interpret. Therefore we will not further discuss them. Interested readers may study Tables F-15 to F-17 (in Appendix F, one table for each dimension) for details.

SUMMARY AND CONCLUSIONS

Five major dimensions of education are examined with respect to the relationships between them and the academic development of students. A sequential approach is applied to assess the marginal influence of each educational dimension on achievement and the joint influences of the five dimensions. The five dimensions considered are instructional time, characteristics of instructional personnel, educational environment, teacher practices in the class, and the organization of classes for instruction.

The school-year analyses reveal few consistent effects of the educational process on achievement growth. On the basis of the characteristics measured in this study, only the experience of teachers systematically shows a substantially positive effect: students taught by more experienced teachers tend to achieve greater growth. Other educational variables that also have appreciable relationships with achievement progress are primarily the compositional variables that describe the existing conditions of the school. In particular, high concentration of low-achieving students, which suggests that the school may have an unfavorable learning climate and assume a heavy burden of educating the deprived children, has an adverse effect on achievement; this negative effect is consistently shown in math.

With regard to instructional time, again there is little evidence that the amount of special instruction which is mostly provided to compensatory education students has a positive effect on achievement. On the other hand, increasing the amount of regular instruction sometimes helps students to achieve better.

The conclusion of the analyses in this chapter is somewhat discouraging. Because the analyses do not support the effects of most of the operational aspects of education, such as individualization of instruction and principal's leadership, the results are not very helpful to the design of effective programs. We suspect that the unproductiveness of the analyses may be in part explained by the lack of valid measures for the important aspects of education. Frequently, variables of conceptual importance are measured distally. For example, individualization is described in terms of the degree of differences between teacher treatments of low-achieving and regular students. What is more relevant, however, may be the nature of such differences.

It may be argued that one problem of the present analysis is that effectiveness of particular educational methods can be shown only for specific groups of students because there are likely interaction effects between the educational process and student characteristics. To address this problem, we will further examine the associations between the effects of education and student characteristics in a later chapter (Chapter 8). Meanwhile, we also suggest that more structured studies that make in-depth observations of the classes to record more specific details of the interactions between teachers and students and the way instruction is actually delivered would prove more fruitful in the research for effective programs. In addition, we believe that the effects of education may require a longer period than a single school year to become noticeable.

CHAPTER 7. THE CHARACTERISTICS OF EFFECTIVE EDUCATIONAL PROCESSES

In order to determine the characteristics of the educational processes that are effective in improving achievement, the findings with multiple-regression analyses in the preceding chapter are summarized by grades and by subject areas. It is concluded that few of the obviously manipulable characteristics show consistent effectiveness in enhancing achievement. Moreover, there are few meaningful differences among grades with regard to the effects of various educational-process variables. The educational dimension that appears to be consistently related to achievement growth is one that reflects the existing conditions of the school: a school's low-achiever concentration is negatively related to achievement growth, while school's minority concentration shows positive associations with growth. With respect to other dimensions, only teacher experience systematically exhibits a positive (but not strong) relationship with growth.

Additionally, the technique of discriminant analysis is applied to our data to assist us in identifying the educational methods that promote achievement. Two groups of students having 'high' and 'low' achievement gains, relative to gains of their peers with comparable pretest achievement, are created for the analyses. The roles of the educational variables in the discrimination between 'high' and 'low' growth students are examined in an effort to verify their effects on achievement as determined in the earlier regression analyses. The agreement between the findings from the different analytic methods supports the conclusion that, on the basis of our data, few variables are identified as important characteristics of the effective processes. Nevertheless, our analyses suggest a general picture that relatively more effective programs are characterized by more experienced teachers: more regular instruction, more feedback to students regarding their performance, and an environment with few disturbances of instruction.

In this chapter we examine in a different way the same issues addressed in the previous chapter, with an eye toward shedding light on the contributors to achievement growth that can be manipulated by educators and policy makers. Specifically, two groups of students with relatively 'high' and 'low' achievement growth were created for each grade and each subject, and stepwise discriminant analyses were applied in order to identify the educational variables useful for discriminating the groups. In these analyses, student background characteristics were disregarded because of their uncontrollable nature. This practice is not to be confused with that of ignoring differential effectiveness of educational methods according to student characteristics. The issue of differential effectiveness can be best addressed by subgroup analyses (or analyses of interactions) and will be investigated in the next chapter. There, the effects of interactions between student characteristics and the educational process variables on achievement growth will be examined, and similar discriminant analyses that involve only CE students will be implemented to address partially the important concern of differential effectiveness.

Another related comment is that initial ability, which can affect achievement growth, was also not taken explicitly as a potential discriminator. However, both initial ability and student characteristics have been indirectly considered in the analyses because the formation of the two growth groups was made with specific reference to the pretest scores (see a later section for descriptions). To the extent the pretest score could serve as a proxy for a composite measure of initial ability and background characteristics, the latter variables were in effect taken into account in the analyses. Aside from the role of the pretest score in the classification of students into the two analyses groups, an indicator of achievement status corresponding to the pretest quartile score was also employed to control for possible biases due to regression artifacts in the grouping procedure.

The discussion of the present chapter will concentrate on the relative effectiveness of the educational process variables that can be modified in program designs, and on possible differences in their effectiveness among grades. Before we begin a series of new analyses, the findings from Chapter 6 are reviewed to ascertain any consistent differences (or similarities) in the characteristics of effective educational processes among grades.

EFFECTIVE EDUCATIONAL PROCESSES BY GRADES

Based on the full-model regression analyses using data from the entire sample reported in the previous chapter (see Tables 6-7 and 6-8), the significant process variables for each grade and subject are listed in Table 7-1 along with the sign of their regression coefficients.

Findings in Reading. Time allocated to regular classroom instruction shows a significant positive effect in three of the six grades (1, 2, and 5), suggesting that regular instructional time is important for achievement growth in the lower grades. This finding is in agreement with that of other studies (e.g., Coles et al., 1976; Guthrie et al., 1976) as noted in the previous chapter. Among the educational process variables, only 'Years of Teaching' makes fairly consistent and positive contributions to the prediction of reading achievement gain. No other characteristics have significant unique contributions in more than two grades. School CE concentration is found to have an effect of improving reading achievement in the first two grades, likely reflecting the greater effectiveness of reading CE in these early grades. Another observation worth noting is that 'Weekly Homework Assigned' has a positive and significant effect in grade 1 and again in grade 6. This finding probably implies the importance of homework in the beginning year of learning to read and in the upper grades when extra-curricular reading helps improve comprehension and unusual vocabulary. Inspection of the patterns of the signs of regression coefficients for the remaining variables discloses no systematic trends across grades that may lead to meaningful interpretations of the differences. On the negative side, school's low-achiever concentration is significant in grades 2, 3, and 6. These negative effects could be a consequence of the need for greater efforts to raise the achievement levels of lower-achieving students, but some schools with high concentrations could still have insufficient resources to meet their students' needs, even with CE funds.

Findings in Math. More time for regular instruction effects greater growth in grades 5 and 6 instead of grades 1 and 2 in reading. This reversal from the situation in reading may be explained by the fact that emphasis on math increases with grades. In the earlier grades, instruction concentrates on reading in order to lay a foundation for learning other skills, while in the later grades more instruction in math is required to promote learning of the more complex math skills.

Significant effects of the educational process variables are more numerous in math than in reading. On the positive side, the following effects are observed in Table 7-1:

- 'Years of Teaching' is significant in grades 1 and 2, and then again in grades 5 and 6. The nonsignificant finding in grades 3 and 4 could signify a transition in these two grades before novel concepts such as sets and complicated computations such as those involving decimals are introduced in higher grades.

- 'School's Minority Concentration' has significant contributions in grades 2 through 4. These results are consistent with the evidence that for CE students, greater gains were achieved by minorities than others (see Chapter 4). A plausible explanation would be that minorities tend to have fewer opportunities to learn math skills outside the school and benefit more from instruction.

- 'Weekly Homework Assigned' is important in grades 1 and 2 and again in grade 6, a trend similar to that observed in reading. This finding suggests that in the earlier grades, some exercises at home could reinforce learning in school while by grade 6 extra-curricular practice is again needed to master the more complex skills.

- Frequent provision of feedback on student progress is helpful to learning in grades 2 and 6.

Table 7-1

Educational Process Variables With Significant Effects on Achievement Growth and the Sign of Their Regression Coefficients, for Reading and Math by Grade*

Variables Describing Educational Processes	Reading in Grade						Math in Grade					
	1	2	3	4	5	6	1	2	3	4	5	6
Instructional Services Received												
Regular Instruction	+	+			+						+	+**
Special Instruction		-**	-**						-	+		
Tutor/Independent Work	+						-				+**	
Characteristics of Educational Processes												
Support/Teaching Personnel Ratio						-**						-
Years of Teaching	+	+		+	+**		+**	+			+	+**
Highest Degree Earned			+**									
Recent Inservice Training						+**			-			
Teacher's Belief in Schooling							+					-**
Teacher's Attitude to School Programs											+**	
School's Minority Concentration				+				+	+	+		
School's Poverty Concentration											+	
School's CE Concentration	+	+								-		
School's Low-Achiever Concentration		-	-			-**	-	-	-	-	-	
School's Central Resources	+**						+					
Parent/Community Involvement	-**				+**						+	
Principal's Instructional Leadership	+**		-**									
Teacher's Involvement in Decisions											-**	
Disturbance of Instruction	+**				-**						-	
District's Percent of Administrative Staff		-**	+**						+			
Efforts in Planning and Evaluation					+**							
Teacher's Use of Lesson Plans											+**	
Frequency of Feedback Per Semester									+			+
Weekly Homework Assigned	+					+**	+	+				+
Individualization of Instruction					-**				-	-		+
Monthly Use of Materials								+				
Monthly Use of Audio-Visual Equipment					-**							
Extent of Ability Grouping										-**		

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*A summary of the results presented in Tables 6-7 and 6-8 of Chapter 6. Blanks in the entry indicate that the corresponding variables had non-significant effects.

**Unique contribution to R^2 is less than one-tenth of one percent.

Other significant results included the following:

- On the negative side, we again find the consistent effects of 'School's Low-Achiever Concentration' in grades 1 through 5. This observation may be explained in the same way as in reading. No other consistent similarities among grades are observed.

- 'Individualization of Instruction' shows mixed effects: negative in grades 3 and 4 but positive in grade 6. There could be an implication that when more complex skills are to be learned as in grade 6, instruction according to individual need becomes useful. Differences among grades in the effectiveness of the remaining variables do not lend themselves to apparent and meaningful interpretations.

Summary of Findings. Few of the obviously manipulable characteristics of educational process show consistent effectiveness in enhancing achievement growth, or have meaningful differential effectiveness across grades. The noteworthy results are:

- In both reading and math, 'Years of Teaching' generally exhibits a positive relationship, although not strong, with achievement growth.

- More time in regular instruction is important in effecting greater achievement growth in the first two grades for reading, but in the higher grades (5 and 6) for math.

- 'Weekly Homework Assigned' has positive effects in grades 1 and 6 for both reading and math, but not in the middle grades (3 through 5).

- Two variables, which reflect the existing conditions of the school and are less controllable than educational practices, are consistently related to achievement growth: school 'Low-Achiever Concentration' contributes negatively to the prediction of reading and math achievement in most grades, while 'Minority Concentration' contributes positively to the prediction of math achievement in grades 2, 3, and 4.

In the next section, discriminant analyses are applied to analyze the same data in order to provide further insights into the effective educational processes in different grades.

DISCRIMINANT ANALYSES FOR IDENTIFYING EFFECTIVE EDUCATIONAL PROCESSES

Additional analyses using the techniques of stepwise discriminant analysis were performed at each grade for reading and math to describe the discriminating power of the variables for services and educational processes in distinguishing between students of greater growth and less growth.

For reading and for math separately, time spent in the three instructional settings and characteristics of educational processes that were selected in earlier hierarchical stepwise-regression analyses (see Chapter 6) in at least one grade are pooled to serve as potential discriminating variables for the present analyses. These variables were listed in the first column of Tables 6-7 and 6-8 for reading and math respectively (minus the pretest and student charactertistics). As mentioned earlier in this chapter, the pretest quartile score was also employed as a control variable for adjusting possible biases due to regression artifacts. In addition, selection for CE services was used to reflect specifically the effects of CE that may not have been associated with the discriminating variables. This residual effect of CE may include influences of student characteristics as well as other unmeasured educational dimensions. Two additional variables, one for reading and one for math, were developed to designate the group membership ('high' and 'low' growth) for each student in terms of his/her achievement growth in the respective skill during the school year.

Parallel analyses were performed for reading and math employing corresponding analysis groups and discriminating variables. These discriminant analyses were motivated by a concern that effective educational methods were often determined on the basis of results from regression analyses. Whether these methods indeed efficiently differentiate successful programs from unsuccessful ones at the program level, or more important, whether differential exposures to the component processes of these methods in fact discriminate between students of larger and smaller gains have rarely been verified.

We therefore decided to strengthen the findings of the earlier regression analyses with validations of the discriminating power of the effective educational variables.

Student Grouping in Terms of Achievement Growth

Ideally, the posterior predictive distribution function (Box and Tiao, 1973; Zellner, 1971) for the posttest scores given the student background characteristics and pretest scores should be employed to determine if student growth is higher or lower than expected on the basis of the data we have accumulated. Unfortunately, such predictive distribution functions differ (in parameters) for each distinct combination of values for the background variables and pretest scores. The calculations of the probability that the predicted posttest score exceeds the obtained score for each student would be very costly. Therefore, we opted for some less sound procedures to identify the students with noticeably larger and smaller growth than expected. Specifically, we created two separate indicators employing each student's 'z-score' gain and simple VSS gain (see Chapter 2).

Growth Indicator Based on Standardized-Score Gain. For the first indicator of growth (reading and math separately), the student is assigned to the 'high' group if his/her 'z-score' gain exceeds zero by at least one standard deviation of the 'z-score' gain in the population, and is assigned to the 'low' group if it falls below zero by at least one standard deviation. Those students with 'z-score' gains falling between the one standard-deviation range are assigned to the 'average' group. The standard deviation of 'z-score' gain in the population is estimated by $\sqrt{2}(1-r)$, where r is the average test-retest correlation between the fall and spring VSSs as reported in Table 1-15 of Report 9. The estimated standard deviations for z-score gains to be used in the creation of this growth indicator are presented in Table G-1 of Appendix G. This rule is selected because one expects a student to maintain his/her relative achievement status under normal circumstances. This method of calculating the group-membership indicator, then, is especially sensitive to students who have grown unexpectedly much or little, relative to the population to which they belong.

Growth Indicator Based on Vertical-Scale-Score Gain. For the simple VSS gain, the indicator was determined based on the projected average growth for a group of students who have similar pretest achievement status. The pretest percentile ranks were blocked into ten categories (deciles). Then, if a student's VSS gain from fall to spring exceeds the projected mean VSS gain by at least one standard deviation for his/her group (decile), the student is assigned to the 'high' growth category. If the student's VSS gain falls below the projected mean for his/her group by at least one standard deviation, the student is assigned to the 'low' growth category. A VSS gain falling between the one standard-deviation range of the projected mean for the appropriate decile group is assigned to the 'average' category. The reason that the pretest percentile ranks were blocked by the deciles for the determination of student growth status is in part due to the considerations of differential expected growth for students at different achievement levels, and the possible ceiling and floor effects of the tests administered, particularly for the groups of students having extreme scores. The projected means and standard deviations for the construction of this second growth indicator were presented in Table B1-1 of Appendix B1.

Definition of Student Groups. The two indicators are combined in order to form the analysis groups:

- 'High-Growth Students'. Students are 'high' on both of the component indicators based on z-score gain and VSS gain.

- *'Low-Growth Students.'* Students who are 'low' on both of the component indicators.
- *'Average-Growth Students.'* All the remaining students who are not classified into the 'High-Growth' or 'Low-Growth' groups.

Achievement Growth and CE Status. Once each student could be classified into a 'high', 'average', or 'low' growth category in a fairly reliable manner (the reason we employed two different approaches), it seemed promising to tabulate the students by their categories of growth and their CE-status to see if any groups at any grades had relatively more of some type of student than other groups did. Summary data of the cross-tabulations are presented in Table 7-2 (Table G-2 in Appendix G provides more complete information from which Table 7-2 has been extracted).

The entries in Table 7-2 may be interpreted as 'success rates' on the basis that high values represent the movement of students into the 'high-growth' category and out of the 'low-growth' category. If it is also assumed that in the population the ratios, by chance, approximate 1.00 (based on the notions of a symmetrical distribution of achievement scores from which the growth categories were calculated), then additional meaning may be added to these data. In this respect, it should be remarked that inspection of the last column of Table G-2 reveals some tendency for larger proportions of 'low' growth than 'high' growth students. This could in part be explained by the inclusion of purposively selected samples, especially the comparison schools, such that 'low' growth students are disproportionally represented in the total sample.

Adopting this frame of reference, we found no consistent pattern for the ratios over the grades or among the six CE groups in reading. The only noticeable consistency is that for CE students within Title I schools; Title I students tend to have higher ratios than do non-Title I students, with an exception in grade 6. The picture for math is quite different. In five of the six grades (except for grade 2), Title I students achieve the highest ratios among the three groups of CE students. In fact, for grades 3 through 6, Title I students also show higher success rates than any of the three groups of non-CE students. Other-CE students, however, attain lower success rates than non-CE students with few exceptions. In both reading and math, erratic patterns of ratios over grades emerge for Other-CE students, possibly a reflection of the wide variations of types of students and programs that comprise these other-CE categories. These summary findings support earlier results that CE, specifically Title I, is more effective in math than in reading.

The Stepwise Discriminant Analysis

Using the 'high' and 'low' growth groups in each grade and for each subject, a stepwise discriminant analysis was performed to select efficient discriminators. The potential discriminatory variables, as explained in the beginning of this section, are listed in Tables G-3 and G-4 of Appendix G for reading and math, respectively. The readers are reminded of the addition of the pretest quartiles and CE status to the set of educational variables in order to control for possible selection biases in the analysis groups. The purpose was to see if these two variables have any discriminating power. Their roles in the distinction between the two groups could affect the interpretation of the results. For instance, if pretest achievement plays an important role in the discrimination, it may suggest that the definition of the analysis groups ('high' and 'low' growth) is largely correlated with pretest score (even though we attempted to reduce such a correlation by blocking) and, thus, interpretations should be made with special caution.

The same set of potential discriminators was used for all grades, but the analyses were performed separately for each grade. Consequently, different sets of discriminators may be selected for different grades. Our aim is to compare the set of useful discriminators obtained across the grades. The results provide us with additional information on the characteristics of effective educational services, and their differences among grades.

The summary statistics obtained in the stepwise discriminant analyses, helpful for a thorough understanding of the final results, are presented in Tables G-3 and G-4 of Appendix G for reading and math, respectively. These two tables present the means of each potential discriminator for each group ('high' and 'low' growth groups), along with indicators of whether the means for the two groups are significantly different. We present the means because they provide some references for interpretations of the discriminant functions.

Table 7-2

Ratios of Number of Students of 'High' Growth to Number of Students of 'Low' Growth in Reading and Math by CE Category and Grade

Grade	Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Non-CE Students in Title I Schools	Non-CE Students in Other-CE Schools	Students in Non-CE Schools
			Reading			
1	.57	.54	.39	1.11	.80	1.03
2	.79	.58	1.29	.82	.97	.64
3	.94	.69	1.10	1.05	1.19	1.02
4	.64	.61	.75	.94	.88	1.04
5	.62	.50	.86	.86	1.08	.98
6	.95	.98	.42	.96	.80	.89
			Math			
1	1.12	.72	1.11	1.16	.85	.71
2	.69	.60	.85	.94	1.10	.73
3	.98	.52	.37	.84	.88	.91
4	1.21	.70	.39	.88	.94	1.00
5	1.29	.57	.97	.89	1.18	1.20
6	1.08	.82	.52	.78	.71	.69

Group Differences With Respect to the Educational Variables. The data in Table G-3 for reading are summarized below. Pretest achievement status is significantly different between the two groups in all grades. CE participation rates also differ significantly between the groups in grades 1, 4, and 5. Where differences exist, the 'low' growth group tends to have higher initial achievement and higher proportion of CE students. Even with our definitions of the growth groups, where assignment of group membership was conditioned on pretest status, differences in initial achievement still are important. Apparently, the distributions of the gain scores are skewed in some groups of students, especially those who score at the top and bottom quartiles in the pretest. The skewness of the distribution may be explained by regression artifacts, ceiling and floor effects, and the fact that there are few difficult items left for the high pretest scorers and many easy items for the low pretest scorers to answer correctly to obtain higher posttest scores. Consequently, the chance errors may cause proportionally more students with higher pretest scores to fall into the 'low' group, and more with lower pretest scores to fall into the 'high' group. Such misassignment of group membership is particularly probable for those who score at the 99th and the 1st percentiles in the pretest. The former cannot be assigned to the 'high' growth group because the upper bound for their z-score gains is zero, while the latter cannot be assigned to the 'low' growth group because of a lower bound of zero for their z-score gains.

The joint observation of lower initial achievement quartiles and higher proportion of CE students for the 'low' growth group suggests a hypothesis that some students in the 'low' growth group may have attained unusually high pretest scores by chance but still are recognized as having need for compensatory assistance and receive CE services. As a result of the measurement error in the pretest, they tend to exhibit lower gains than others in the same achievement group. On the other hand, some students in the 'high' growth group may have scored low by chance but actually have higher ability and do not receive CE services. This type of measurement error in turn results in higher apparent gains in comparison with those made by others of similar pretest scores. As remarked in Chapter 2, whenever pretest scores are employed directly as the basis for grouping, there will be some regression artifacts. These summary findings point to a situation where a greater number of CE students with high pretest scores are assigned to the 'low' growth group. In anticipation of such confounding factors for the discriminant analysis, the pretest quartile scores and the indicator for CE status have been used in the analyses so that they may be selected into the discriminant function to adjust for the effects of these factors.

In cases where differences exist, the group with 'high' reading growth tends to receive more regular instruction, but less in special instruction, and spends more time in independent work. This group also tends to have teachers with more years of teaching experience. The results across grades are generally inconsistent for the other variables, however.

Table G-4 presents the means for the two groups for math. Once again, the 'high' growth group tends to have lower initial achievement, but there is little difference in proportion of CE students. Again, the regression artifacts due to measurement errors as well as the floor effects of tests offer some plausible explanations for the lower initial achievement quartiles of the 'high' growth group.

Where there are differences, the 'high' growth group receives more regular instruction. There are also significant differences in amount of independent work in grades 1 and 2, but the direction of the differences is not the same in the two grades. In grades 2, 3, and 5, 'high' growth groups have teachers with more years of teaching experience. In addition, students having 'high' growth on the average receive more feedback from their teachers in all grades. The degree of individualization of instruction, while showing significance, demonstrates inconsistent directions of difference between the two groups.

With respect to school conditions, the 'high' growth students tend to be in schools having lower minority concentrations, lower poverty concentrations (grades 2, 3, and 5), and lower concentrations of low achievers (grades 3 and 5). The schools attended by 'high' growth students also tend to have lower CE concentration (grade 3 through 5, but an opposite result is found in grade 1). Finally, there are fewer instructional disturbances in the schools where the 'high' growth students come from. The differences of means of the remaining variables are either inconsistent or tend to be insignificant.

Results of the Discriminant Analysis for Reading. The results of the stepwise discriminant analyses are provided for reading in Table 7-3. In this table all the potential discriminators are listed, along with their standardized coefficients for the final discriminant functions. In the lower part of the table we present summary statistics for the selected discriminant function. They include the mean discriminant scores for the two groups, statistical tests of the discriminating power of the function, canonical correlation, and correct classification rates using the function. The latter two statistics are also provided for the complete discriminant function using all potential discriminatory variables (28 for reading) so that the efficiency of the selected discriminant function with a reduced number of variables can be assessed.

The data in Table 7-3 reveal that the results of reading vary considerably over grades. Only the pretest achievement and CE status play a role in the discriminant functions for all six grades. After adjustment for differences in these two variables, special instruction is still negatively related to the growth category in four of the six grades ('lower' growth students tend to receive more special instruction). Instructional services play a stronger role in discriminating the growth groups at the lower grades than at the higher grades.

Table 7-3

Stepwise Two-Group ('High' vs 'Low' Fall-to-Spring Growth) Discriminant Analyses for Examining the Effects of Instructional Services Received, and Characteristics of Educational Process on Student Reading Achievement Growth*

Discriminating Variables Selected by the Stepwise Discriminant Procedure	Standardized Discriminant Function Coefficients (Beta)											
	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta
Student Characteristics												
Pretest Achievement Quartile	1	-.79	1	-.95	1	-1.12	1	-.93	2	-.72	1	-.74
Participation in Compensatory Education	2	-.52	5	-.36	5	-.36	2	-.56	3	-.50	8	-.50
Instructional Services Received												
Regular Instruction	3	.26	9	.14	NA		NA		4	.35	11	.26
Special Instruction	15	-.09	3	-.22	2	-.36	3	-.43	NA		NA	
Tutor/Independent Work	10	.17	10	.10	4	.17	NA		NA		12	.20
Characteristics of Educational Process												
Staff/Student Ratio	7	-.19	NA		NA		NA		5	-.30	NA	
Support/Teaching Personnel Ratio	11	-.09	11	-.09	NA		NA		NA		5	-.28
Years of Teaching	9	.15	4	.19	7	.19	5	.27	NA		2	.40
Highest Degree Earned	NA		12	.11	NA		NA		NA		4	-.30
Recent Inservice Training	NA		16	-.09	NA		NA		NA		3	.33
Attitude to School Programs	14	.11	NA		9	-.15	NA		NA		NA	
School's Minority Concentration	8	.30	2	-.39	NA		NA		NA		NA	
School's CE Concentration	5	.46	6	.28	6	.27	NA		7	.30	9	.48
School's Low-Achiever Concentration	6	-.54	7	-.28	3	-.46	NA		1	-.63	6	-.51
Parent/Community Involvement	NA		8	.13	NA		NA		NA		NA	
Disturbance of Instruction	13	.13	NA		NA		4	-.25	9	-.23	NA	
District's Percent of Administrative Staff	NA		14	-.10	10	.12	NA		NA		NA	
Effort in Planning and Evaluation	NA		NA		8	.18	NA		NA		10	.20
Teacher's Use of Lesson Plans	NA		15	-.09	NA		NA		NA		7	.25
Frequency of Feedback per Semester	17	-.08	NA		NA		6	.26	6	.24	NA	
Weekly Homework Assigned	12	.10	NA		NA		7	-.23	NA		NA	
Monthly Use of Materials	4	.19	13	.09	NA		NA		NA		NA	
Individualization of Instruction	NA		NA		NA		NA		8	-.22	NA	
Classroom Achievement Level	16	.08	NA		NA		NA		NA		NA	
Statistics for the Discriminant Function												
Mean Discriminant Scores	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
'High' Growth Group	1,426	.498	1,236	.473	1,312	.372	1,024	.221	1,293	.254	1,611	.203
'Low' Growth Group	1,612	-.441	1,461	-.400	1,240	-.394	1,212	-.187	1,498	-.220	1,770	-.185
Wilk's Lambda	.780		.811		.853		.959		.944		.962	
Chi-Square Test Statistics**	751.2		564.2		403.7		94.6		159.5		130.0	
Canonical Correlation (Squared)	.469	(.220)	.435	(.189)	.383	(.147)	.204	(.042)	.236	(.056)	.194	(.038)
Percent of Correct Classification	69.5		68.2		66.5		59.4		59.3		58.3	
When all 28 Potential Discriminators are used												
Canonical Correlation (Squared)	.474	(.225)	.439	(.193)	.391	(.153)	.232	(.054)	.250	(.063)	.207	(.043)
Percent of Correct Classification	69.6		68.5		66.8		59.3		59.7		60.1	

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*Two groups of students with comparatively 'High' and 'Low' growth from Fall-to-Spring were formed for the discriminant analysis for each grade. The groups comprise students having reading achievement growth one s.d. above and below, respectively, the average growth of their peers with comparable fall achievement. Please refer to the text for a detailed account of the grouping procedure. The potential discriminators employed include pretest achievement status, CE status, three kinds of instructional services received, and 23 educational process variables that were found in the earlier analyses to be effective in predicting posttest scores for at least one of the six grades (see Table 6-7). The selection criteria of the discriminators in the stepwise procedure are 4.0 for "F-to-Enter' and 3.9 for 'F-to-Remove'.

**Degree of freedom = number of discriminators selected; all chi-squares are significant at the .01 level.

With regard to instructional personnel, 'Years of Teaching' serves as a useful discriminator in five of the six grades (except for grade 5), indicating that more experienced teachers may promote achievement. Additional noteworthy results are that high CE concentration and low concentration of low achievers in the school are systematically associated with 'high' growth in all grades except grade 4. The exception in grade 4 is another reflection of the general results that few variables contribute to explanation of reading achievement growth in this grade. 'Frequency of Feedback per Semester' tends to be related to 'high' growth in grades 4 and 5, but has a weak association with 'low' growth in grade 1. Discriminating powers for the remaining variables either fail to exhibit consistent patterns or do not suggest meaningful differences among grades. On the whole, the results of these discriminant analyses tend to reinforce the findings of the previous chapter (Chapter 6).

It may be seen in the bottom section of Table 7-3 that, although all the discriminant functions are highly significant, the canonical correlations and the percents of correct classification made by the discriminant functions decrease with increasing grades. The rates of correct classification, furthermore, are not very high. Inclusion of all the potential discriminators into the function does not improve the discriminating power appreciably. It can therefore be concluded that the reduced set of discriminating variables is satisfactory for the present purpose.

To summarize the results of the discriminant analysis for reading, we list below the first three educational-process variables that effectively distinguish between the two growth groups. A positive association with the 'high' growth group is indicated by a '+' in parentheses, while a negative association is indicated by a '–'.

Grade 1: Regular Instructional Services Received (+)
Monthly Use of Materials (+)
School's CE Concentration (+)

Grade 2: School's Minority Concentration (–)
Special Instructional Services Received (–)
Teacher's Years of Teaching (+)

Grade 3: Special Instructional Services Received (–)
School's Low-Achiever Concentration (–)
Tutor/Independent Work (+)

Grade 4: Special Instructional Services Received (–)
Disturbance of Instruction (–)
Teacher's Years of Teaching (+)

Grade 5: School's Low-Achiever Concentration (–)
Regular Instructional Services Received (+)
Staff/Student Ratio (–)

Grade 6: Teacher's Years of Teaching (+)
Teacher's Recent Inservice Training (+)
Teacher's Highest Earned Degree (–)

In comparison with the results based on regression analyses, the present results tend to accentuate the negative effects of special instruction on growth. As explained earlier, this finding is very likely a consequence of the practice of allocating services according to need. The finding for 'Years of Teaching' is in agreement with that from the regression analysis.

In passing, a few remarks may be of interest. The failure to find a uniform set of characteristics of effective education processes for all grades is evident. In addition, few meaningful interpretations are obvious for the wide variations of effective educational processes over grades. A similar situation occurred in the Compensatory Reading Study (Trismen, Waller and Wilder, 1976) where comparisons between effective and ineffective schools were unable to obtain interpretable differences or consistent similarities among grades regarding characteristics of effective educational methods. The fact that some educational variables, such as staff/student ratio (more teachers), individualization of instruction, and principal's instructional leadership (quality of administration), were seldom found to be effective is somewhat incongruous with the evidence reported in previous studies (see a summary in Table 18 of McLaughlin, 1977).

Results of the Discriminant Analyses for Math. The results for the math analyses, reported in Table 7-4, are a bit more consistent than those for reading (as was also true for the regression analyses of the previous chapter). After adjustment for pretest achievement and/or CE status, receipt of regular instruction makes consistent and positive contributions to the differentiation between the groups. The effects of time in regular instruction were made more apparent in these analyses than in the regression analyses. Work with tutor or independently makes similar contributions at all but the second grade. Receipt of special instruction plays a small and inconsistent role, largely because of its association with lower pretest scores. More years of teaching experience is associated with 'high' growth in grades 2, 4, 5, and 6.

High concentration of low achievers in the school differentiates between the growth groups in the first five grades in the direction that high concentration is related to 'low growth'. CE concentration in the schools is a favorable condition for growth in the first two grades. As in reading, frequent feedback to students is helpful to achievement in grades 4 through 6. More homework assigned is related to 'high' growth in grades 1, 2, and 6. Favorable teacher attitude to school programs tends to contribute to 'high' growth in four of the six grades (except in the two middle grades, 3 and 4). In grades 4 through 6, disturbance of instruction is associated with 'low' growth, but a reversed relation is found in grade 2. The overall results indicate a greater number of variables selected as useful discriminators than that found significant in the regression analyses.

The remaining variables show inconsistent results across grades or do not contribute significantly to discrimination between the groups in more than one grade.

The canonical correlations and percentages of correct classification decrease slightly in the upper two grades, but they are generally larger than those for the reading analyses in grades 3 through 6. The stepwise procedure again effectively selected the useful discriminators, as there was little reduction in the canonical correlation and rate of correct classification in all grades as a result of discarding some of the 30 potential discriminators.

In summary, the first three contributors to the distinction between the growth groups in math (as determined by the stepwise procedure), excluding pretest and CE status, are listed below by grades. The directions of the relationships are indicated by '+' or '–' in the same way explained earlier for the reading analyses.

Grade 1: School's Low-Achiever Concentration (–)
Tutor/Independent Work (+)
School's CE Concentration (+)

Grade 2: School's Low-Achiever Concentration (–)
Teacher's Years of Teaching (+)
School's CE Concentration (+)

Grade 3: School's Low-Achiever Concentration (–)
Principal's Instructional Leadership (–)
Regular Instructional Services Received (+)

Grade 4: Disturbance of Instruction (–)
School's Low-Achiever Concentration (–)
Individualization of Instruction (–)

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Table 7-4

Stepwise Two-Group ('High' vs. 'Low' Fall-to-Spring Growth) Discriminant Analyses for Examining the Effects of Instructional Services Received, and Characteristics of Educational Process on Student Math Achievement Growth*

Discriminating Variables Selected by the Stepwise Discriminant Procedure	Standardized Discriminant Function Coefficients (Beta)											
	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta
Student Characteristics												
Pretest Achievement Quartile	1	-.90	1	-.97	1	-.94	1	-.92	1	-.77	1	-.88
Participation in Compensatory Education	5	-.30	4	-.40	6	-.13	10	-.14	NA		NA	
Instructional Services Received												
Regular Instruction	10	.08	11	.09	4	.15	15	.08	4	.29	10	.19
Special Instruction	NA		8	-.10	NA		9	.20	NA		NA	
Tutor/Independent Work	3	.21	NA		5	.08	14	.13	5	.23	11	.17
Characteristics of Educational Process												
Support/Teaching Personnel Ratio	11	-.08	NA		NA		NA		NA		7	-.24
Years of Teaching	NA		3	.22	NA		16	.09	6	.19	13	.14
Recent Inservice Training	16	.08	NA		NA		NA		NA		NA	
Belief in Schooling	7	.17	NA		NA		NA		NA		9	-.12
Attitude to School Programs	8	.16	6	.12	NA		NA		9	.13	5	.21
School's Minority Concentration	NA		10	-.16	NA		12	.18	NA		12	-.15
School's Poverty Concentration	NA		NA		7	.19	NA		NA		NA	
School's CE Concentration	4	.41	5	.31	NA		NA		NA		NA	
School's Low-Achiever Concentration	2	-.38	2	-.33	2	-.65	3	-.34	2	-.50	NA	
School's Central Resources	12	.12	NA		NA		NA		NA		NA	
Parent/Community Involvement	NA		NA		NA		13	-.11	7	.18	NA	
Principal's Instructional Leadership	NA		NA		3	-.16	NA		NA		NA	
Teacher's Involvement in Decisions	6	-.22	NA		NA		5	-.14	NA		NA	
Disturbance of Instruction	NA		9	.11	NA		2	-.20	3	-.28	2	-.27
District's Percent of Administrative Staff	13	.09	NA		NA		7	-.14	11	-.12	NA	
Effort in Curriculum Development	NA		NA		NA		6	.15	NA		NA	
Teacher's Use of Lesson Plans	NA		NA		NA		NA		10	.12	14	.10
Frequency of Feedback per Semester	NA		NA		NA		8	.14	8	.10	3	.23
Weekly Homework Assigned	9	.10	7	.14	NA		NA		NA		4	.27
Monthly Use of Materials	NA		NA		NA		11	-.11	NA		NA	
Individualization of Instruction	14	.10	NA		NA		4	-.20	NA		8	.17
Monthly Use of Audio-Visual Equipment	15	-.10	NA		NA		NA		NA		NA	
Class Size	NA		NA		NA		NA		12	.11	6	.18
Statistics for the Discriminant Function												
Mean Discriminant Scores	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
'High' Growth Group	1,639	.419	1,328	.441	1,192	.530	1,301	.450	1,347	.379	1,570	.373
'Low' Growth Group	1,572	-.437	1,432	-.409	1,385	-.456	1,423	-.411	1,337	-.382	2,003	-.292
Wilk's Lambda	.817		.819		.759		.815		.855		.891	
Chi-Square Test Statistics**	647.9		548.4		709.5		554.8		418.5		411.7	
Canonical Correlation (Squared)	.428	(.183)	.425	(.181)	.491	(.241)	.430	(.185)	.381	(.145)	.330	(.109)
Percent of Correct Classification	69.1		68.0		71.1		68.9		65.2		64.4	
When all 30 Potential Discriminators are used												
Canonical Correlation (Squared)	.432	(.187)	.434	(.188)	.499	(.249)	.436	(.190)	.389	(.151)	.337	(.114)
Percent of Correct Classification	69.3		69.1		70.8		68.7		67.2		64.4	

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[*] Two groups of students with comparatively 'High' and 'Low' growth from Fall-to-Spring were formed for the discriminant analysis for each grade. The groups comprise students having math achievement growth one s.d. above and below, respectively, the average growth of their peers with comparable fall achievement. Please refer to the text for a detailed account of the grouping procedure. The potential discriminators employed include pretest achievement status, CE status, three kinds of instructional services received, and 25 educational process variables that were found in the earlier analyses to be effective in predicting posttest scores for at least one of the six grades (see Table 6-8). The selection criteria of the discriminators in the stepwise procedure are 4.0 for 'F-to-Enter' and 3.9 for 'F-to-Remove'.

[**] Degree of freedom = number of discriminators selected; all chi-squares are significant at the .01 level.

Grade 5: School's Low-Achiever Concentration (−)
Disturbance of Instruction (−)
Regular Instructional Services Received (+)

Grade 6: Disturbance of Instruction (−)
Frequency of Feedback Per Semester (+)
Weekly Homework Assigned (+)

As evidenced from this list, the school's Low-Achiever Concentration was selected first in four of the six grades, and second in one grade (the entry order is determined excluding that for pretest and CE status). Characteristics of educational environment are found to be frequent contributors to differentiation between the 'high' and 'low' growth groups.

Conclusions From the Stepwise Discriminant Analyses. In general, there are more educational variables found to be significant and consistent discriminators for math growth than for reading growth; the same findings held in the multiple regression analyses of Chapter 6. Although the two variations of analysis in terms of linear models are expected to yield similar results, we have designed the two approaches so that they can provide complementary information.

The lists of discriminating variables for both reading and math do not provide us with information that can be incorporated into some meaningful model of education that might change systematically over the grades. Nor does it provide us with much information useful to guide decisions about what services and practices are most promising, if there are any.

Further Analyses in Order to Obtain Consistent Findings Over Grades

As an adjunct to the stepwise discriminant analyses, we calculated additional functions from a further-reduced set of variables, in an effort to obtain some consistent and meaningful information that could prove helpful. First, we eliminated from consideration any variable from Tables 7-3 and 7-4 that had only one significant coefficient (per table). Second, we eliminated any variable that had only two, but differently signed, coefficients in adjacent grades. Last, we eliminated all variables that are not directly controllable by educators, i.e, the compositional variables. (This condition may be somewhat ambiguous; for example, we consider that a school's concentration of CE is not controllable, although technically many CE programs could be thoughtlessly spread to all students in the school. We believe that such a thoughtless policy, however, is not one we'd want to consider as a potential recommendation from our discriminant analyses. Such a recommendation would most likely represent an insensitive misinterpretation of the findings.) These variables describe peer-group characteristics in a school and are most appropriately viewed as situations that can be adverse or beneficial to achievement growth. Their effects on educational development of students would most likely be explainable through their influence on other operational characteristics of the school's programs and their direct relation to their student characteristics.

Basically, we depart from the explorative, fact-finding approach of the preceding sections, and concentrate on obtaining a comprehensive set of findings, even if they make marginal contributions. We trust that 'every little bit of help counts', and that our adjunct analyses will provide consistent and meaningful 'little bits' of help. There were 15 variables selected for these additional discriminant analyses for both reading and math, although they were not the same set of variables. Three sequential reductions for the reading variables and four for the math led to the final lists of variables that made fairly consistent and meaningful contributions to the differentiation between the 'high' and 'low' growth groups. The variables that remained, their standardized coefficients for the discriminant functions, and summary statistics for the functions are presented in Table 7-5.

The trade-off for obtaining the fairly consistent and meaningful discriminant functions is a substantial loss of discriminating power, as indicated by the reductions in canonical correlation and percent of correct classification. Comparing the data in Table 7-5 with those in Tables 7-3 and 7-4, we find that the reduction from 28 and 30 discriminating variables to seven and six for reading and math,

Table 7-5

Discriminant Functions for Reading and Math That Differentiate Between 'High' and 'Low' Growth Students, Based on a Small Set of Manipulable Variables

Discriminating Variables	Standardized Coefficients*					
	Gr. 1	Gr. 2	Gr. 3	Gr. 4	Gr. 5	Gr. 6
	Reading					
Regular Instruction	.73	(.22)	(.09)	.49	.69	.43
Tutor/Independent Work	.46	(.06)	.44	.44	(.15)	.41
Years of Teaching	.49	.76	.51	.46	.31	.49
Disturbance of Instruction	.30	-.26	(-.27)	-.40	-.61	-.35
Effort in Planning and Evaluation	(.06)	.26	.57	(.18)	(.14)	.35
Teacher's Use of Lesson Plans	(-.10)	-.29	(.03)	(.22)	(.19)	.30
Frequency of Feedback per Semester	(.03)	.25	(.22)	.48	(.12)	(.26)
Percent of Correct Classification	57.5	57.2	54.5	54.1	56.1	54.8
Canonical Correlation	.21	.17	.12	.11	.15	.12
Mean of 'Low' Group	-.19	-.15	-.12	-.10	-.14	-.11
Mean of 'High' Group	.22	.19	.12	.12	.16	.12
Percent of Correct Classification With All 15 Selected Variables	62.3	57.5	54.0	55.0	55.5	57.7
	Math					
Regular Instruction	.30	.35	.48	(.20)	.47	.14
Tutor/Independent Work	.75	-.23	.40	(.03)	.31	.35
Years of Teaching	.26	.63	(.13)	(-.07)	.39	(.12)
Attitude to School Programs	.40	.34	(-.18)	(.27)	.34	.35
Disturbance of Instruction	(-.04)	(.01)	-.65	-.80	-.61	-.58
Frequency of Feedback per Semester	.35	.28	.43	.47	.21	.60
Percent of Correct Classification	56.5	57.4	57.6	56.4	57.5	56.0
Canonical Correlation	.13	.17	.15	.13	.22	.13
Mean of 'Low' Group	-.12	-.16	-.14	-.12	-.22	-.12
Mean of 'High' Group	.13	.18	.16	.13	.22	.15
Percent of Correct Classification With All 15 Selected Variables	58.7	58.0	57.2	58.4	59.4	57.8

*The coefficients are enclosed in parentheses for the variables that would not be selected if criteria of 4.0 for 'F-to-Enter' and 3.9 for 'F-to-Remove' were used.

respectively, results in considerable decreases in percent of correct classification. These decreases generally range from 8 to 13 percent except in reading at the upper grades. For reading, the decreases are approximately 3 to 5 percent in grades 4 to 6. This finding is largely explainable by the observations that the pretest quartile, CE status, and the compositional variables (i.e., concentrations) are the discriminators to enter early into the previous discriminant functions. These variables generally have greater discriminating power and when eliminated are likely to cause reductions in the overall efficiency of the discriminant functions.

For the reading analyses, the compositional variables, however, did not enter early into the function in the upper three grades.

Table 7-5 also provides the percentages of students correctly classified when all the 15 variables selected for the analyses are used to obtain the discriminant functions. Comparison of these percentages with those obtained in the final analyses that use a smaller set of variables (seven in reading and six in math) shows very little reduction in the classification ability of the discriminant functions. It should be noted, however, that the functions have little discriminating power, as evidenced by the low canonical correlations and the small (albeit significant) improvement over correct classification by chance alone.

Five of the contributing variables are common to both reading and math (but they were not selected on that basis). In general, we can see that the amount of regular instruction, the amount of work with a tutor or independently, the teacher's years of teaching experience, and the frequency of feedback per semester are all associated with 'high' growth. Disturbance of instruction is generally adversely related to achievement growth, but the relationship is not very strong in the lower grades. More important, it does not show the same negative relationship with growth in both reading and math for grade 1. This deviant case was also noted in Summers and Wolfe (1977). Perhaps at this early stage of schooling, children are not aware of the disruption and therefore are not affected by it.

In reading, teacher's use of lesson plans still does not exhibit consistent and substantial contributions to discriminating power, though there is slight evidence that in the upper grades it is related to 'high' growth (possibly because at the higher grades more content is being taught, and it needs organization to be effectively presented to the students). Teacher efforts in planning and evaluation are positively related to 'high' growth, but not strongly at most grades. In math, teacher attitude toward the school's program is positively related to 'high' growth in all grades but grade 3.

SUMMARY AND CONCLUSIONS

Although the results of these adjunct analyses are not particularly encouraging, they suggest a general picture of more effective educational processes that are characterized by:

- Teachers with more years of teaching experience
- Receipt of more regular instruction
- More time in work with tutor or independently
- More frequent feedback to students (especially in math)
- An environment with few disturbances of instruction

A review of the results in Tables 7-3 and 7-4 shows support for this same conclusion. We feel that this picture is closer to the idea of 'traditional' American education than it is to the current conceptions of compensatory education (that frequently stress innovation and special instruction). The good intentions of CE programs in specifying services that will be especially effective were not validated in the present analyses.

CHAPTER 8. THE EFFECTS OF EDUCATIONAL PROCESSES AND STUDENT CHARACTERISTICS

In order to help educators design programs that best serve their students and to further our understanding of the achievement process, we investigate how the effects of education differ for different kinds of students. For this purpose, we employ multiple-regression models to examine the effects on achievement of the interactions between educational dimensions and student characteristics. No clear picture emerges from the analysis concerning what educational methods are most effective for what kinds of students.

In reading, the few significant interactions seem to support the conclusion that educational aspects emphasized by CE programs tend to be more beneficial to the achievement of students who are more likely to receive CE. While this abstracted finding is encouraging, the reader is warned that we have little confidence of its practical meaning considering that each result is obtained only in an isolated grade. In math, most of the interactions involve the schools' existing conditions that are determining factors of receiving CE funds; the few other interactions that involve manipulable characteristics of the educational process are weak and not shown in more than one grade. Thus, our analysis does not provide much insight into the differential effects of the educational process on the achievement of different groups of students.

Because we are particularly concerned about the design of effective CE programs, we further employ the technique of discriminant analysis to help us identify the educational factors that account for the differences between CE students having high and low achievement gains. The analysis fails to find any educational methods that are particularly beneficial to achievement for CE students, while not for all elementary students. Among the variables that can be reasonably manipulated, only teacher experience and amount of work with tutor or independently are consistently related to achievement growth of CE students (and also of other students): more experienced teachers and more independent work are helpful.

On the whole, we conclude that these analyses do not substantially increase our understanding of the relationships between the educational process and achievement. We suspect that further progress in this area would require better data on the home environment, teacher, and classroom behaviors.

In the previous chapters, we studied the characteristics of educational process that are effective in promoting achievement regardless of student backgrounds. We now extend our investigations to consider how student characteristics can influence the effects of educational methods. The primary goal is to find some consistency in the relationships between educational process and achievement so as to help us implement changes that can be expected to effect greater achievement.

Toward this end, the relationships between instructional services and achievement growth were examined, in Chapters 3 and 4, with special emphasis on the achievement of CE students. The search for effective educational processes was broadened in Chapter 6, where we considered all students and included characteristics of teachers, classroom practices, school conditions, and policies of organizing instructional classes. In each analysis, we also employed student characteristics, such as race/ethnicity and poverty, to control for their preexisting differences with respect to achievement. As few findings were satisfactorily consistent and significant, the issue was addressed further in Chapter 7 by contrasting the educational experiences of students having relatively 'high' and 'low' growth. Although we found some characteristics of educational programs that separated students with 'high' growth from those with 'low' growth, the results were again not consistent and meaningful for the purpose of devising a comprehensive achievement model.

In this chapter, we continue our inquiry in this regard by focusing on the differences in the effects of various educational dimensions among students having different characteristics. We suspect that the previous findings are inconsistent and lack meaning because we have not taken into account differential effects according to student characteristics. Sometimes, the effect of an educational variable on achievement varies (and even changes its direction) depending on the characteristics of students. In such cases, the analysis that examines the overall effect of a variable, disregarding the difference in student characteristics, can produce inconsistent findings over grades (because of varying student compositions) or fail to reveal the effect.

Recently, a study by Summers and Wolfe (1977) concluded that there was considerable variation in the effects of some school inputs among students grouped by race, income, or achievement level. In the present analyses, we hope to gain a better understanding of the effective educational processes by examining their effects according to certain student characteristics that may intervene or moderate the relationship between achievement and educational experiences. It is important to note that, from a scientific point of view, the approach represents an improvement of model specification that may lead to a clearer view of reality. However, from a political point of view, it can sometimes be misperceived as advocating that subgroups of children are different in how they respond to education (which might lead to a recommendation for separate and unequal educational services—a condition not legally acceptable.. Despite this concern, we take the approach with a conviction that the increased knowledge, if uncovered, is important in itself, and will be carefully considered by policy makers. Only by recognizing the differential effects, if they exist, can educators design programs that best serve their students.

The present analyses are aimed at determining if the effects of instruction and educational practices on achievement are dependent on student characteristics. In other words, we explore the possibility that different types of children benefit differently in their achievement growth from the various dimensions of educational process (see Jensen, 1969; Bereiter and Engelmann, 1966, for points of view in line with this thinking). We study this question through a regression approach with analysis steps parallel to those of Chapter 6. An alternative approach would be to perform subgroup analyses, i.e., to estimate the effects of educational variables for each subgroup separately. However, joint consideration of student characteristics would result in a large number of subgroups such that the computational work would quickly become very time consuming and costly.

In order to keep the analysis simple and manageable, we assume that the main effects of student characteristics and the interaction effects of each educational process variable with student characteristics are additive. This kind of model is reasonable considering that our previous analyses (see Chapter 2) found little interaction between student characteristics in predicting achievement scores. Moreover, the number of higher-order interaction terms can multiply rapidly, and these interaction terms often correlate substantially with lower-order terms so that their estimations are likely to be unstable. Thus, the adopted regression model represents a practical compromise.

In addition to the student characteristics used in the analyses of Chapter 6 as control variables, a few others are added. All the student characteristics are briefly described here for reference. (The first six are based on the report of homeroom teachers in the Study Background Checklist; see Chapter 4 of Report 9 for further details.)

- *Race/Ethnicity.* A dichotomous variable indicating whether the student is non-Hispanic white (= 1) or minority (= 0).

- *Participation in Meals Program* A dichotomous variable indicating whether the student participates in a free or reduced-price meals program. This variable serves as a proxy for family economic status.

- Previous Receipt of CE. A variable indicating whether the student received CE services (separately for reading and for math) in the 1975-76 school year, i.e., prior to the year in which the data for this report were collected.

- *Teacher Judgment of Need for CE.* An index, separate for reading and for math, indicating each student's homeroom teacher's judgment of whether or not the student needs CE services.
- *Mother's Educational Attainment.* A variable indicating whether the student's mother completed high school. This variable serves as a proxy for home intellectual environment.
- *Parental Involvement in School Activities and Child's Education.* An index of the amount of involvement and interaction each student's parent(s) had with the school during the school year.
- *Summer Intellectual Experience.* A variance indicating the amount of activities each student engaged in during the summer that had academic or intellectual components, obtained separately for reading and math. (This index is derived from the Summer Activity Slipsheet.)
- *CE Status.* An index of whether the student received reading or math CE services (separately) in the 1976-77 school years, based on school coordinators' response on the Compensatory Education Roster.

The pretest score is also used to adjust for initial differences in achievement. The instructional services are measured in terms of yearly hours spent in each of the three instructional settings as explained in Figure 6-1. The set of educational process variables used is different for each grade and each subject, and is the same as that employed to examine the combined effects of characteristics of educational programs on achievement (see Tables 6-7 and 6-8 for reading and math respectively). The analysis steps parallel those of Chapter 6 insofar as the regression analyses are performed in a hierarchical stepwise fashion.

No clear picture emerges from our analyses concerning the nature of the interaction effects between student characteristics and the educational process on achievement. Only a few educational variables interact with student characteristics to produce differential effects on achievement. In such cases, the interactions, though significant, are generally small and not clearly interpretable. How the effects of the educational process vary with student characteristics remain an open question. Nevertheless, we attempt to offer some possible interpretations of the significant interactions in order to aid future inquiries into this area.

EXPLORATORY ANALYSES OF INTERACTIONS WITH STUDENT CHARACTERISTICS

As in Chapter 6, we first attempt to clear the field a bit by performing preliminary analyses with a 15 percent random sample from the data for each grade. The reason for the preliminary analyses is economic: the total number of independent variables is very large when all possible first-order interactions between the student characteristics and the educational variables are examined. The model would include hundreds of regression variables, and the results, in addition to being very costly, would also be difficult to interpret because of the complex interrelationships (intercorrelations) among so many predictors. Therefore, the data for the 15 percent random samples are analyzed first to select important interactions between each of the five sets of educational variables (kinds and amounts of instruction, instructional personnel, educational environment, educational practices, and classroom organization) and the eight student characteristics.

The present approach to the study of these interactions requires the generation of the equivalent of 'interaction terms' (Cohen and Cohen, 1975; Neter and Wasserman, 1974) for the regression models. The interaction term for an education variable 'A' with student characteristics 'Z', for example, is the algebraic product of multiplying each student's value for 'A' by his/her value for 'Z', so that a new variable, 'A x Z,' is created. These interaction terms are then added to the list of variables that will be used as predictors of achievement or achievement growth.

Analysis Procedures. The analyses were performed for each grade and for each subject separately. At the first stage, five subanalyses, one for each of the five sets of interaction terms associated with the above five sets of educational variables, were carried out in parallel ways in each case. At each step of the selection procedure, the model always includes the following variables: the pretest score, student background characteristics, instructional-service variables, and the set of educational-process variables selected previously for the respective grade and subject (see Tables 6-17 and 6-18). In the presence of all these 'main effect' terms, the interaction terms between student characteristics and the educational variables were examined separately for each of the five sets to determine which interactions will be retained for further analyses. A significance level of .05 was used as the criterion for the forward selection and backward elimination strategy.

In total, there were 60 such regression analyses performed (two subjects x six grades x five sets of interactions). Each of these analyses includes a large number of regressions. Because of the voluminous results of these analyses, we report only the summary findings in Appendix H (see Table H-1 for reading and Table H-2 for math). These tables indicate which of the interaction terms entered their respective regression equations with significant contributions.

Once a subset of significant interactions was determined for each of the five educational dimensions, these subsets of interactions were examined simultaneously in a second-stage analysis so that their interrelationships can be taken into account in selecting the final analysis model. Again, all main-effect terms included in the first-stage analyses were entered first to the regression model, and then the interaction terms were introduced into the regression model via the stepwise procedure. The interactions that remained significant for the prediction of achievement growth in this last analysis step were selected for subsequent analyses. The interactions so selected are indicated in Tables H-1 and H-2 with double checks (✓✓).

A single check (✓) in the entry of these tables shows that the corresponding interaction term was selected in the first screening stage that examined the five sets of interactions separately, but not in the second stage when all five subsets of retained interactions were considered jointly.

Results of the Preliminary Analysis for Reading. From Table H-1, it may be seen by inspecting the number of checks in each column that 'Judged Need for CE' and 'Parental Involvement' are most likely to interact with various characteristics of educational processes to produce differential effects of the latter on achievement growth. Teacher's Judgment of Need for CE is closely related to Student's Achievement Level; the present result implies likely interactions of the educational-process variables with achievement level. Differential effects of educational methods by achievement level are often a concern of researchers (e.g., Summers and Wolfe, 1977) and will be examined in our later analyses through these interaction terms.

When the rows in Table H-1 are inspected, we find that within a grade, few of the educational variables interact with more than two student characteristics. Furthermore, with only one exception, none of the educational variables interacts with the same student characteristics in more than one grade. (The lone exception is that the interaction between teacher experience and student CE status is significant at the .05 level in grades 1 and 3.) The infrequent observation of significant interactions and the lack of consistent results over grades suggest that the differences in the effects of these educational variables among different groups of students are not prominent.

In general, an interaction that is significant when each set of interactions pertaining to a particular educational dimension is considered alone (marked with ✓) tends to remain significant when interactions from all five sets are considered together. Thus, there is little evidence that the interaction effects between each of the five educational dimensions and the student characteristics are substantially intercorrelated.

Results of the Preliminary Analyses for Math. The results for the math analyses, reported in Table H-2, indicate that the student characteristics interacting most frequently with the educational variables for the latter to affect achievement growth are 'Judged Need for CE' and 'CE Status in 1976-77'. It is interesting to note that both characteristics are closely associated with achievement level.

Looking within a grade, it may be seen that again most educational variables interact significantly with only one student characteristic. Although there are more significant interactions in math than in reading, the results are still very inconsistent across grades. Only the interaction between a teacher's experience and a student's race/ethnicity is significant in more than one grade (grades 1 and 4) at the second selection stage. As in reading, the significances of selected interactions tend to be similar regardless of whether the five sets of interactions are examined separately or simultaneously.

Conclusions From the Preliminary Analyses. Based on the preliminary analyses, it is not promising that we will find any pronounced interactions between the educational process variables and student characteristics with regard to their effects on achievement growth. The results show little evidence that the effects of educational variables vary consistently with student characteristics. The different results among the grades reveal no systematic patterns and their implications are not clear. Despite the pessimistic outlook, we proceed to analyze the data for the entire sample with the model resulting from the preliminary screening. The results are discussed in the next section in an effort to improve our understanding of the nature of effective educational processes.

THE INTERACTIONS BETWEEN EDUCATIONAL PROCESSES AND STUDENT CHARACTERISTICS

We now analyze the data for the entire sample using the model selected in the preliminary analyses in order to study how the effects of educational processes vary with student characteristics. The basic model includes the pretest score, the eight student characteristics described at the beginning of this chapter, and the educational-process variables shown to be related to achievement growth (see Tables 6-7 and 6-8) as the independent variables; and the posttest score as the dependent variable. The differential effects of the educational variables are examined by expanding the basic model to include the interaction terms, selected on the basis of the preliminary screening (see Tables H-1 and H-2), as additional independent variables. For convenient reference in our discussion, this expanded model is referred to as the model with interaction; the basic model is referred to as the model without interaction.

The interaction effects are assessed in terms of the regression coefficients for the interaction terms and their unique contributions to the explanation of the variance in posttest scores. The results are interpreted with special emphasis on how the effects of the educational variables are related to student characteristics.

Findings From the Reading Analyses. Table H-3 of Appendix H presents the results from the reading analyses based on the model with interactions (using data for the entire sample). The increments to squared multiple correlation (R^2) by the interaction terms collectively are not at all substantial, ranging from near 0.0 to 0.4 percent, with smaller increments at the higher grades. Further, it may be noted that the regression coefficients for the 'main-effect' variables do not change much in value or sign from the analysis in Chapter 6, where the model assumes no interaction between student characteristics and educational processes (see Table 8-1 for a summary). We conclude, therefore, that we do not substantially improve our understanding of the effects of the educational dimensions by considering their interactions with the characteristics of the students.

Nonetheless, the unique contributions of the combined interaction terms are statistically significant except in grade 4. The regression coefficients for some of the interactions are also significant. (Note that a significance level of .01, instead of the .05 used in the preliminary selection procedures, was adopted for the present discussion because of the large sample sizes.) To provide at least a partial cross-validation of these results, identical analyses were also performed using data from the 15 percent random samples that constitute the data base of our preliminary analyses (henceforth referred to as the reduced sample). Similar results for these reduced-sample analyses are presented in Table H-4 of Appendix H.

Table 8-1

Significant Regression Coefficients for the Educational Process Variables and Their Signs as Determined by the Analyses With and Without Interactions, for Reading and Math by Grade (Based on Results From the Analyses Using the Entire Sample)†

Educational Variables Significant at the .01 Level	Reading by Grade						Math by Grade					
	1	2	3	4	5	6	1	2	3	4	5	6
Regular Instruction	+	+			+			+*	+*	+*	+	+
Special Instruction	+*	-**	-**							+		
Tutor/Independent Work	+						+		+*	+*	+	+*
Staff/Student Ratio			+*									
Support/Teaching Personnel Ratio						-						-
Years of Teaching	+	+		+	+		+	+		-*	+	+
Highest Degree Earned			+									
Recent Inservice Training	-*					+			-**			
Belief in Schooling							+					-
Attitude to School Programs											+	
School's Minority Concentration				+				+	+**	+		
School's Poverty Concentration											+	+*
School's CE Concentration	+	+								-		
School's Low-Achiever Concentration		-	-			-	-	-	-	-	-	
School's Central Resources	+						+					
Parent/Community Involvement	-+				+						+	
District Control of Instruction	+*											
Principal's Instructional Leadership	+**		-									
Teacher's Involvement in Decisions											-**	
Disturbance of Instruction	+				-						-	
District's Percent of Administrative Staff		-	+						+			
Effort in Planning and Evaluation					+**							
Teacher's Use of Lesson Plans							-*				+	
Frequency of Feedback per Semester									+			+
Weekly Homework Assigned	+**					+	+	+**		+*		+
Monthly Use of Materials								+				
Individualization of Instruction					-				-	-**		+
Monthly Use of Audio-Visual Equipment					-**							
Extent of Ability Grouping										-		

†The results of analyses without interactions were extracted from Tables 6-7 and 6-8, while the results of analyses with interactions were extracted from Tables H-3 and H-5 of Appendix H, for reading and math, respectively. In the analyses without interactions, a few student characteristics were also omitted.

-+Reversal of the sign of the regression coefficients in the two analyses: the first sign indicates that obtained in the analysis without interactions, and the second indicates that obtained in the analysis with interactions.

*Significant only in the analyses with interactions.

**Significant only in the analyses without interactions.

No asterisks in the entry indicates significance in both analyses.

Inspection of Tables H-3 and H-4 reveals that the squared multiple correlations for both models with and without interactions are comparable between the reduced-sample and the whole-sample analyses. The largest discrepancy between the two analyses is found in grade 1 when the model with interactions is applied (R^2 - .531 and .482 for the reduced and the whole sample, respectively). In all other cases, the discrepancies are either about or less than 1 percent. Additionally, the significances of the unique contributions by the interactions collectively are also similar between the two analyses using different samples; but the estimates of the interaction effects differ considerably between the samples (see more discussion later).

In order to see how the inclusion of the interaction terms and the additional student characteristics into the present analyses would affect the estimates of the regression coefficients for the educational variables, we compare, in Table 8-1, the signs and significances of the common educational variables used in the analyses presented in Tables 6-7 and H-3 for reading. (In the same table, we also compare the corresponding data for math by summarizing results in Tables 6-8 and H-5.) From Table 8-1, it may be seen that in reading there are 37 significances found for all six grades and all educational variables involved in the two analyses. Among these significant coefficients, four are significant only in the present analyses (Table H-3), six are significant only in the analyses presented in Chapter 6 (Table 6-7), and one is significant in both analyses but with a reversal of sign.

Inspection of Tables 6-7 and H-3 reveals that the signs of the coefficients for Parent/Community Involvement in grade 1 are different largely as a result of the interaction between this variable and the White/Minority status. The negative coefficient for this interaction implies that minority students benefit more from Parent/Community Involvement than do the Whites. Hence, the estimate of the main effect for this variable can vanish or become negative if white students do not benefit from it and the interaction is not considered. This is so because the sample includes more whites than minorities as it should in order to reflect the composition of the population.

The remaining 26 significances are in agreement between the two analyses. Overall, these comparisons show that the estimates for the effects of the educational variables are quite robust, another confirmation that interactions contribute little to the explanatory power of the model.

For the regression coefficients, Table 8-2 summarizes the significant interactions found in the reading analyses using the reduced and the whole sample. Data in this table show considerable disagreement between the results of the two analyses. Among the ten significant interactions in the six grades, two were significant only for the reduced sample and three were significant only for the whole sample. This leaves only five occasions that are in agreement between the samples. One normally expects many more significances when the extremely large sample (the whole sample) is used, but such an expectation cannot be confirmed unequivocally by these data. The lack of congruence in the two sets of results regarding interactions suggests that the estimates of the regression coefficients for these interactions could be quite unstable. For this reason, only the five interactions that show significance in both samples are interpreted:

- *Interaction Between Parent/Community Involvement in School Programs and Student's White/Minority Status.* In grade 1, the negative coefficients for this interaction and the positive coefficients for the main effects of Parent/Community Involvement together imply that minority students benefit more from a program that encourages Parent/Community involvement. It could be because of the emphasis of such involvement in CE programs (Title I in particular) that serve primarily minority, poor, and low-achieving students.

- *Interaction Between School Low-Achiever Concentration and Student Need for CE.* In grade 3, the main effect of school's low-achiever concentration is negative and the interaction between Low-Achiever Concentration and CE Need has a positive regression coefficient. These observations reveal that the condition of high concentration of low achievers in the school has less perverse effects on the achievement growth of students judged to have need for CE. This is presumably because of the greater likelihood for the students with educational need to receive additional help such as CE.

Table 8-2

Significant Interaction Effects Between Student Characteristics and the Educational Process on Reading Achievement (Results From the 15 Percent and the Entire Sample)

Interaction Terms Significant at the .01 Level†	Grade					
	1	2	3	4	5	6
Highest Degree Earned x PI			-*			
Recent Inservice Training x RACE						-
School's CE Concentration x NEED		+**				
School's Low-Achiever Concentration x NEED			+			
School's Low-Achiever Concentration x PI		+*				
Parent Community Involvement x RACE	-					
Disturbance of Instruction x PI					-**	
Disturbance of Instruction x SUMI					+	
Effort in Planning and Evaluation x CE76					+	
Weekly Homework Assigned x PI						-*

† PI = Parental Involvement in child's education; RACE = 1 for Non-Hispanic Whites and 0 otherwise; NEED = Teacher's judgment of the student's need for reading CE (1 for having the need and 0 otherwise); SUMI = Student's summer intellectual experience; and CE76 = CE status in 1976-77 (1 for CE students and 0 for non-CE students).

* Significant only in the analyses using the entire sample. The plus (or minus) sign in the entry shows that the interaction term has a positive (or negative) coefficient.

** Significant only in the analyses using the 15 percent random sample. No asterisk in the entry indicates significance in both analyses using the 15 percent and the entire sample.

- *Interaction Between Disturbance of Instruction in School and Summer Intellectual Experience of the Student.* In grade 5, Disturbance of Instruction exhibits negative influences on achievement growth but less so for the students with greater intellectual experience during the summer. The index for Summer Intellectual Experience primarily reflects summer-school attendance which is often voluntary. We suspect that, ceteris paribus, the students who volunteer for summer school tend to be more motivated than their similar peers (even among the low-achieving students) and may be distracted less from their learning by disturbance in the school. As a result, disturbance of instruction might have smaller adverse effects on the achievement of students with greater summer intellectual experience.

- *Interaction Between Teacher Effort in Planning and Evaluation and Student CE Status.* In grade 5, the main effect for Effort in Planning and Evaluation is not significant but there is a positive interaction between it and student CE status. This finding indicates that this variable is positively associated with the achievement growth of CE students but not for the non-CE students. Considering the fact that CE promotes teacher effort in planning and evaluation, this result may be regarded as supportive of the benefits of such emphases.

- *Interaction Between Teacher Recent Inservice Training and Student White/Minority Status.* In grade 6, Recent Inservice Training received by teachers has a positive impact on achievement growth and this impact is greater for the minority students than for the whites. Again, the finding suggests some connection with CE because of the importance of inservice training for teachers in CE programs.

In summary, these interactions suggest that the educational aspects that are emphasized by CE programs tend to have greater (positive) effects on the achievement of students who are more likely to receive CE. However, the findings are so inconsistent across grades, we have little confidence of their practical meaning.

Findings From the Math Analyses. The detailed results of the analyses for math are presented in Table H-5 of Appendix H. These analyses employed the model with interactions and included the entire sample of students. The increments to R_2 by the interactions, although statistically significant at all grades, range from only 0.1 to 0.7 percent. As in the regression analyses of Chapter 6 and the discriminant analyses of Chapter 7, we observe more significant predictors for math posttest scores than for reading. Still, the consideration of the interactions does not substantially increase our understanding of how the educational process influences math achievement.

For the purpose of cross-validation, the same analyses were also performed with data from the 15 percent random sample used in earlier exploratory analyses. The results of these reduced-sample analyses are presented in Table H-6 of Appendix H. Comparison of the data in Tables H-5 and H-6 reveals that the R^2 for the whole sample is always smaller than the corresponding value for the reduced sample as often expected (on the basis of the rationale for calculating adjusted R^2). The increases range from 1.6 to 4.6 percent when the analyses are based on the model with interactions. Both analyses using the reduced sample and the entire sample show consistent significances over grades for the unique contributions of the interactions collectively. Comparison of the estimated regression coefficients for the interaction terms, however, discloses considerable differences between the two analyses (see later discussion).

The influences of the inclusion of additional student characteristics and the interaction terms into the current analyses on the estimates of the regression coefficients for the educational variables can be examined by comparing the data in Tables 6-8 and H-5. A summary of the data in these two tables was provided in Table 8-1 to facilitate the comparison. It may be seen from the second part of this table (for math) that of the 50 significant coefficients obtained in the analyses either with or without interactions for the six grades, ten are significant only when the model includes the interactions (Table H-5), and five are significant only when the interactions are omitted (Table 6-8). This leaves 35 coefficients that are significant and of the same direction in both analyses. As in reading, these results suggest that the estimates of the effects of the educational variables are quite robust, in part reflecting the small contributions of the interactions in the prediction of math achievement.

We now describe the interactions between the educational process and student characteristics by examining the regression coefficients for the interaction terms. Table 8-3 summarizes the significant interactions obtained in the analyses with the reduced sample (Table H-6) and the whole sample (Table H-5). Combining the results for the six grades, we find that in a total of 25 significant interactions, six are significant only in the whole sample and nine are significant only in the reduced sample. The remaining ten coefficients are significant in both samples. Again the discrepant results cannot be explained by the anticipation of more significances when the sample size is much larger. These findings suggest that estimates of the interaction effects are not stable across samples. To a certain extent, this lack of stability is an indication of the tenuous interaction effects being studied. Taking the same strategy adopted in our discussion of the reading analyses, we will interpret only the interactions whose significances are consistent between the two samples:

- *Interaction Between Time Spent Working With Tutor or Independently and Student White/Minority Status.* In grade 4, the main effect of Tutor/Independent Work is positive but there is an interaction between this variable and Race/Ethnicity. The negative coefficient for this interaction shows that this kind of instruction does not have as much (positive) impact on the achievement of white students as on that of minority students. This is possibly because minority students are likely to benefit from additional practice in learning math skills as they may not have as much opportunity for practice outside the school.

Table 8-3

Significant Interaction Effects Between Student Characteristics and the Educational Process on Math Achievement (Results From the 15 Percent and the Entire Sample)

Interaction Terms Significant at the .01 Level[†]	Grade					
	1	2	3	4	5	6
Regular Instruction x NEED	+**					
Tutor/Independent Work x RACE				-		
Support/Teaching Personnel Ratio x FMP					-	
Years of Teaching x RACE	-*			+*		
Years of Teaching x NEED				+		
Years of Teaching x SUMI		+**				
Recent Inservice Training x MOED			+**			
Belief in Schooling x CE76	-**					
School's Minority Concentration x NEED		-**				
School's Poverty Concentration x RACE						-**
School's Poverty Concentration x NEED					+	
School's Poverty Concentration x PI						-*
School's CE Concentration x CE75				-		
School's CE Concentration x NEED				+		
School's Low-Achiever Concentration x RACE			-			
School's Low-Achiever Concentration x FMP		+*				
School's Low-Achiever Concentration x CE75			+			
School's Low-Achiever Concentration x CE76	+	-				
Parent/Community Involvement x CE76		+*				
Teacher's Use of Lesson Plans x FMP	+*					
Frequency of Feedback per Semester x NEED				+**		
Weekly Homework Assigned x CE76		+**				
Extent of Ability Grouping x MOED				+**		

[†] NEED = Teacher's judgment of need for math CE (1 = yes; 0 = no); RACE = White/Minority status (1 for Non-Hispanic White and 0 for all others); FMP = Participation in free or reduced-price meals programs (1 = yes, 0 = no); SUMI = Summer intellectual experience (amount of summer activities that have intellectual components); MOED = Mother's education (1 = completion of high school, 0 = otherwise); PI = Parent's involvement in the education of their own child; CE75 = Receipt of math CE in 1975-76 (1 = yes, 0 = no); CE 76 = CE status in 1976-77 (1 = participating, 0 = not participating).

[*] Significant only in the analyses using the entire sample. The plus (or minus) sign in the entry shows that the interaction term has a positive (or negative) coefficient.

[**] Significant only in the analyses using the 15 percent random sample. No asterisk in the entry indicates significance in both the 15 percent and the entire sample analyses.

- *Interaction Between Support/Teaching Personnel Ratio and Student Participation in Free-Meal Programs (a proxy for family economic status).* In grade 5, there is no significant main effect for Support/Teaching Personnel ratio, but the variable interacts with student economic status in that it has negative impact on the achievement of children from low-income families. This reinforces the idea that instruction by teachers is likely to be more effective than other supportive services for disadvantaged children.

- *Interaction Between Teacher Years of Teaching and Student Judged Need for CE.* In grade 4, the main effect of Teacher's Experience is not significant in the analysis without interactions. However, the main effect of this variable becomes significantly negative when interactions are considered. This is the only case in the six grades that a negative effect is found for teacher experience. This deviation from the general pattern may be explained by the significance of its interaction with student need for CE. The positive coefficient for the interaction indicates a tendency for the educationally needy children to benefit more from instruction by more experienced teachers. The overall non-significant effect for this variable may then suggest a negative effect for students not in need of CE. This finding does not agree with that by Summers and Wolfe (1977) who found that low achievers tend to benefit more from reading teachers with three to five years of experience than from those with more years. It is important to note, however, that the present finding is for math only, not for reading. Beginning at grade 4, new math concepts and computational skills are introduced, and low-achieving students are more likely to learn the more complex concepts from more experienced teachers, assuming these teachers have acquired better skills for presenting the new materials and have greater patience to work with low achievers. In passing, it may also be interesting to note that more significant interactions are found in grade 4 than in other grades.

- *Interaction Between School Poverty Concentration and Student Judged Need for CE.* In Grade 5 , the main effect of school poverty concentration is positive. In addition, this variable has greater (positive) effects on achievement for students needing CE than for others. In terms of the policy of targeting CE funds to schools with large percentages of children from low-income families, this result gives some supportive evidence to the success of this policy. That is, the children who are educationally in need and attend schools with high poverty concentrations achieve greater growth than similar children attending schools with low poverty concentrations (this is an interpretation inferred from the main effect). Moreover, the interaction effect shows that the educationally needy children benefit more from being in schools of high poverty concentrations than their non-needy peers (who most likely do not receive CE).

- *Interaction Between School CE Concentration and Student Previous Receipt of CE.* In grade 4, the main effect of school CE concentration is negative. There is also a negative interaction effect with previous exposure to CE, suggesting a greater negative impact of this variable on the achievement of those who received CE in a previous year than on those who did not. This result is difficult to interpret and requires further clarification by the examination of the interaction between school CE concentration and student history of CE participation. We are concerned that insufficient assistance for chronic low achievers in schools having high concentrations of CE students may be the underlying cause for this interaction.

- *Interaction Between School CE Concentration and Student Judged Need for CE.* In grade 4, the negative main effect for school CE concentration and the positive coefficient for its interaction with student CE Need suggest that high concentration of CE students in the school exhibits less adverse effects for the educationally needy children than for the non-needy. This condition in the school may quite likely not be conducive to learning, but such perverse effects may be partially counteracted for students in need of CE as they tend to be those receiving CE.

- *Interaction Between School Low-Achiever Concentration and Student White/Minority Status.* In grade 3, the main effect of School Low-Achiever Concentration is negative and this negative effect is more pronounced for white students than for minority students as indicated by the negative coefficient for its interaction with the white/minority variable. This finding may be related to the greater likelihood for minority students to receive CE and to benefit from the compensatory assistance.

- *Interaction Between School Low-Achiever Concentration and Student Previous Receipt of CE.* In grade 3, the main effect of School Low-Achiever Concentration is negative, but for the students who have previous exposure to CE (in 1975-76) this negative main effect is reduced as implied by the positive coefficient for its interaction with CE receipt in the previous year. If one considers the substantial proportion of students who continue to receive CE from year to year (see Report 5), one may think that this result is possibly related to the effects of CE in the 'current year' (1976-77). But the nature of this interaction requires further study by examining the relationship between the effects of school low-achiever concentration and the effect of CE participation history.

- *Interaction Between School Low-Achiever Concentration and Student CE Status.* In grades 1 and 2, the main effect of School Low-Achiever Concentration is negative. However, this variable interacts with CE status differently in the two grades. In grade 1, CE participation tends to counteract some of the negative main effect, while it tends to accentuate the negative effect in grade 2. We can't quite figure out what the implications are for the latter case of negative interaction. The positive interaction in grade 1 could possibly be related to CE effects.

In summary, there are more significant interaction effects between the educational-process variables and student characteristics for math achievement than for reading. Similar to the case in reading, these interaction effects at times offer some insight into the effects of educational processes and appear to have some connections with CE programs. But this is not the general case, and often the relationships are weak and the implications are ambiguous. Most of the interaction effects involve the compositional variables that describe the existing conditions of the school and, unlike the operational characteristics of educational practices, are not subject to easy manipulation. That we are not able to find the same interaction effects in more than one grade (when interaction effects apply to more than one grade, such as in the last item discussed above, the differences between them cannot be meaningfully interpreted) discourages us from taking the findings seriously.

Conclusions. For both reading and math, the results of the present analyses do not offer much insight into what differential effects the characteristics of educational programs may have on the achievement growth of different groups of students. Our understanding of the relationships between educational inputs and achievement growth is not substantially improved with the information accumulated from the results reported in these last three chapters. Considering our failure to obtain findings that are of consistent pattern or that show meaningful differences among grades, we hesitate to make any definitive conclusions that may inappropriately influence the decisions of educational policy-makers.

THE CHARACTERISTICS OF EFFECTIVE EDUCATIONAL PROCESS FOR CE STUDENTS

The analyses in the preceding section peripherally suggest that the interactions between the educational process and student characteristics, if they exist, tend to have some connection with CE programs. Considering this suggestion and our interest in identifying the characteristics of the educational process that facilitate the success of CE programs, we further examine the nature of effective educational processes by focusing on the achievement of CE students. For this purpose, two groups of CE students having 'high' and 'low' achievement growth are defined, and the same discriminant analysis described in Chapter 7 is applied to determine the dimensions of the educational process that differentiate between the educational experiences of these two groups. Our objective is to learn whether effective processes for CE students differ in any way from those for the general population.

Student Grouping on the Basis of Achievement Growth

The bases for assigning CE students to the analysis groups differ slightly from those used in the last chapter to classify all students. Our interest now is to differentiate two groups of CE students who achieve relatively higher and lower than the average of a standard group or students who are similar to them but do not receive CE. With this reference to the average gain of a standard group, we can think of these two groups of CE students as being 'successful' and 'unsuccessful' with regard to closing the anticipated gap between them and their non-disadvantaged peers.

The standard group used here is one of the comparison group defined in Chapter 2: the group of students who attended non-CE schools and were judged to have need for CE. (See Chapter 2 for an explanation of the usefulness of this group for the purpose of generating the expected growth for CE students in the absence of CE.) This standard group is separately defined for reading and math. The sample statistics for the distribution of fall-to-spring achievement gains in this group provided the bases for assigning CE students to 'high' and 'low' growth groups; these statistics are presented in Table H-7 of Appendix H for reference.

Definition of Growth Groups. Both gains in terms of z-score and VSS (see Chapter 7) were considered in the process of assigning group membership. For each kind of score, if a CE student attained a gain exceeding the mean gain for the standard group by at least one standard deviation (s.d.), then he/she was assigned to the category of 'high' growth. Conversely, if a CE student had a gain falling below the same mean by at least one s.d., he/she was assigned to the category of 'low' growth. The rest of CE students were assigned to the category of 'intermediate' growth.

The two assignments made on the bases of z-score and VSS gains were employed jointly to define the analysis groups. Explicitly, the group of 'high' growth consisted of CE students who were assigned to the 'high' growth category on both bases. The group of 'low' growth was composed of CE students who were assigned to the 'low' growth category in terms of both z-score and VSS gains. All the remaining students belonged to the intermediate group of 'comparable' growth because their gains were judged to be more or less 'comparable' to those of the students in the standard group. This last group was dropped in the discriminant analysis.

The Relationship Between Achievement Growth and Category of CE Programs. Table 8-4 presents the ratios of the number of CE students in the high-growth group to that in the low-growth group, as a way of examining the relative success rates among the three categories of CE programs. Title I students generally have the greatest success rates (with few exceptions), and there is a consistent tendency that they are more likely to be in the high-growth group than in the low-growth group (i.e., the ratios exceed 1.0). The actual numbers and percentages of CE students in each growth group by CE categories can be found in Table H-8 of Appendix H, along with summaries of chi-square statistics for the association between CE category and growth group.

It is interesting to note that, combining all three categories of reading CE students, the proportions of them with 'high' growth tends to decrease with increasing grade, with an interruption in grade 4. The upper three grades have somewhat greater proportions of students with 'low' growth. This finding is consistent with findings reported earlier in Chapter 2, that the effects of reading CE are noticeable primarily in the lower grades. For math, the overall proportions of CE students with 'high' growth are the largest in the first two grades, decrease in grades 3 and 4, and then increase again in grades 5 and 6. It should also be noted that the ratios of the proportions in the two groups are generally higher for math than for reading, supporting earlier findings of greater CE effects in math.

Differences Between the Growth Groups with Respect to Educational Experiences. As supplemental information, we compare the educational process experienced by the high-growth and low-growth groups in terms of the means for the set of educational variables that will be used as potential discriminators for the two groups in the subsequent analyses. These means are presented in Appendix H, Table H-9 for reading and Table H-10 for math. These data are intended for description of the

Table 8-4

Ratios of the Number of CE Students Having 'Higher-Than-Expected' Growth to That Having 'Lower-Than-Expected' Growth, for Three Categories of CE Students by Grade*

Grade	CE Category		
	Title I Students in Title I Schools	Other-CE Students in Title I Schools	Students in in Other-CE Schools
	Reading		
1	1.77	1.67	1.03
2	1.59	1.26	2.09
3	1.79	.88	1.78
4	1.03	.81	.90
5	1.17	.83	1.41
6	1.04	1.08	.56
	Math		
1	2.86	1.68	2.47
2	1.77	1.78	1.86
3	1.88	.84	.63
4	1.81	.91	.49
5	2.06	.94	1.58
6	2.12	1.73	1.18

*Fall-to-spring growth is defined as 'higher-than-expected' if it is one standard deviation or more above the average growth for non-CE students judged to have need for CE but attending schools that do not provide CE in the subject area. Fall-to-spring growth is 'lower-than-expected' if it is one standard deviation or more below that same mean.

different educational programs for the two groups, and to aid us in the interpretation of the results from the discriminant analyses. It should be emphasized that no inference regarding the characteristics of effective programs can be made properly by looking at the mean differences for the variables separately; these differences will be examined jointly in the discriminant analysis for the purpose of making such inferences.

For reading, the average hours of instruction received do not differ significantly between the two groups, except that in grade 1 the 'high' growth group tends to receive more hours of regular instruction. In grades 1, 2, and 5, the Support/Teaching Personnel Ratio is smaller for the 'high' growth group. For all other variables, the mean differences tend to be significant only in grade 1. For this grade, the 'high' growth group tends to be in schools with more inservice training for teachers, higher concentrations of minorities, CE students, and low achievers, greater extent of parent/community involvement, stronger principal leadership for the instructional program, more effort in planning and evaluation, more homework assigned, more use of materials, and more use of audio-visual equipment.

For math, in grades 1 and 4, CE students in the 'high' growth group on the average receive more special instruction, and, in grades 1 and 5, they spend more time working with tutors or independently. In general, there is not much difference in the hours of instruction received between the two groups, except for grade 1. Again, as in reading, differences between the groups are found for more variables in grade 1 than for any other grade. School CE concentration is higher for the 'high' growth group in grade 1, but lower for that group in grades 3, 4, and 5. Elsewhere, the mean differences between groups vary considerably and unsystematically with grades.

In addition to the educational process variables, we also compare the pretest achievement and Title I participation rate between the 'high' and 'low' growth groups of CE students. From Tables H-9 and H-10, we find that for both reading and math the high-growth group tends to have lower pretest scores than the low-growth group, and greater Title I participation rate. The lower pretest scores for students of higher growth suggest that the finding may be partially a result of the regression-toward-the-mean phenomenon, as noted also in Chapter 7.

Discriminant Analysis in Order to Identify the Characteristics of Effective Programs for CE Students

Analysis Procedure. The analysis follows the same stepwise procedure described in Chapter 7. The same set of educational variables serves as the potential discriminators between the growth groups (see Tables H-9 and H-10 for lists of these variables). Additionally, in order to control further the pretest differences among students, the pretest quartile is also included in the analysis. Because the analysis considers only CE students, the CE-status variable used previously in Chapter 7 is replaced with a variable that indicates student participation in Title I programs. The purpose of including this last variable is to control for unobserved differences between Title I and Non-Title I programs, while we attempt to determine which of the observed characteristics are effective in promoting achievement.

Results of the Analyses for Reading. Table 8-5 summarizes the results of the stepwise discriminant analyses for reading. In this table, we present the entry order of the selected discriminators and their coefficients in the resulting discriminant function, the mean discriminant scores for each group, test statistics for the discriminating power of the function, and percents of correct classification using this function.

In the last section of the table, two indexes are provided for the discriminating power of the discriminant function that encompasses all the original 28 potential discriminators. Comparison of the canonical correlation and percentages of correct classification betweeen the selected discriminant function and that using all 28 variables discloses that the addition of variables that were not selected in the stepwise procedure does not substantially improve the discriminant power. The increase in percentages of correct classification ranges from 0.2 percent at grade 1 to 3.1 percent at grade 6. This increase tends to be larger at the upper grades with an exception for grade 3. It may also be noted that both the canonical correlation and the percentage of correct classifications are considerably smaller for the upper three grades than for the lower grades. This phenomenon is consistent with the finding that substantial CE effects are not evident in these three grades (see Chapter 2).

With respect to the instruction received, we find from Table 8-5 that only in grade 1 does amount of regular instruction contribute to the distinction between the two growth groups (it is associated with 'high' growth). Amount of tutor/independent work distinguishes between the two groups in four grades (grades 1, 2, 3, and 6) in that it is positively related to growth. Amount of special instruction, on the other hand, shows some negative relationships to growth in grades 2 and 3.

Turning to other dimensions of the educational process, two variables that reflect conditions of the school differentiate the 'high' from the 'low' growth group fairly consistently: School's CE Concentration tends to be related to 'high' growth in grades 1 and 4, while School's Low-Achiever Concentration tends to exhibit adverse relationships with growth in grades 3, 4, and 5. Among the teacher-level variables, Years of Teaching (in all grades except grade 5) and Effort in Planning and Evaluation (in grades 1, 3, and 5) show noticeable associations with 'high' growth.

Table 8-5

Stepwise Two-Group ('High' vs. 'Low' Fall-to-Spring Growth) Discriminant Analyses for Examining the Effects of Instructional Services Received, and Characteristics of Educational Process on the Reading Achievement Growth of CE Students*

Discriminating Variables Selected by the Stepwise Discriminant Procedure	Standardized Discriminant Function Coefficients (Beta)											
	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta
Student Characteristics												
Pretest Achievement Quartile	1	-.61	1	-.92	1	-1.04	1	-.86	1	-.53	1	-.71
Instructional Services Received												
Regular Instruction	5	.20	NA		NA		NA		NA		NA	
Special Instruction	NA		3	-.27	2	-.19	NA		NA		NA	
Tutor/Independent Work	6	.21	5	.19	4	.20	NA		NA		4	.43
Characteristics of Educational Process												
Staff/Student Ratio	NA		NA		NA		NA		4	-.40	NA	
Support/Teaching Personnel Ratio	NA		NA		NA		NA		3	-.27	NA	
Years of Teaching	10	.12	7	.21	3	.16	6	.26	NA		3	.46
Recent Inservice Training	4	.28	NA		NA		NA		NA		NA	
School's Minority Concentration	NA		4	-.41	NA		NA		6	.73	NA	
School's CE Concentration	2	.46	6	.28	6	.29	7	.28	NA		NA	
School's Low-Achiever Concentration	NA		NA		7	-.22	5	-.44	7	-.53	NA	
School's Central Resources	8	.15	NA		NA		4	.30	NA		NA	
District Control of Instruction	NA		8	.22	NA		3	-.29	NA		NA	
Principal's Instructional Leadership	NA		NA		5	-.17	NA		NA		NA	
Disturbance of Instruction	NA		NA		NA		NA		2	-.59	NA	
District's Percent of Administrative Staff	NA		2	-.24	NA		2	-.36	NA		NA	
Effort in Planning and Evaluation	3	.19	NA		8	.15	NA		5	.27	NA	
Teacher's Use of Lesson Plans	NA		NA		NA		NA		NA		2	.40
Monthly Use of Materials	7	.16	NA		NA		NA		NA		NA	
Classroom Achievement Level	9	.13	NA		NA		NA		NA		NA	
Statistics for the Discriminant Function												
Mean Discriminant Scores	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
'High' Growth Group	564	.404	559	.365	501	.361	475	.271	362	.266	298	.248
'Low' Growth Group	330	-.691	359	-.568	293	-.618	475	-.271	301	-.320	304	-.243
Wilk's Lambda	.721		.792		.777		.927		.915		.940	
Chi-Square Test Statistics**	290.8		212.2		199.3		72.1		58.8		37.2	
Canonical Correlation (Squared)	.529 (.280)		.456 (.208)		.473 (.224)		.271 (.073)		.292 (.085)		.246 (.061)	
Percent of Correct Classification	75.4		71.5		71.4		63.6		61.2		59.5	
When all 28 Potential Discriminators are used												
Canonical Correlation (Squared)	.553 (.306)		.477 (.228)		.491 (.241)		.317 (.100)		.344 (.118)		.327 (.107)	
Percent of Correct Classification	75.6		72.1		72.9		64.2		64.1		62.6	

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[*] The 'High' and 'Low' growth groups created for this analysis comprise Reading CE students whose Fall-to-Spring growth is at least one s.d. above and below, respectively, the average for the non-CE students judged to have need for reading CE but attending schools that do not provide it. The potential discriminators employed include pretest achievement status, participation in Title I programs, three kinds of instructional services received, and 23 educational-process variables that were found to be effective in predicting posttest scores for at least one of the six grades. The selection criteria of the discriminators in the stepwise procedure are 4.0 for 'F-to-Enter' and 3.9 for 'F-to-Remove'.

[**] Degree of freedom = number of discriminators selected; all chi-squares are significant at the .01 level.

All other selected variables demonstrate non-negligible discriminability either in one grade only or in two non-adjacent grades. In some of the latter cases, a reversal of the direction of relationship is obtained. These results of the discriminant analyses present some different pictures from that implied in the univariate comparisons of means for the discriminators between the two groups. As noted earlier, examination of the mean differences alone cannot always reveal the efficient discriminators, due to the multi-variate nature of the problem.

As the main objective of the present analyses is to determine whether the characteristics of educational service and process that help CE students to achieve better are similar to those that are generally effective for all elementary students, we now concentrate on the comparisons between the current results (Table 8-5) and the results presented in Chapter 7 (Table 7-3). A summary of the data given in Tables 7-3 and 8-5 is provided in the first part (for reading) of Table 8-6 for convenient reference.

With respect to instructional services, time spent in regular instruction plays a significant role in distinguishing between the two groups more often when the analyses involve all students than when they concern only CE students. Amount of tutor/independent work has a noticeable contribution to the distinction between the groups in both analyses. For these two kinds of instruction, more time is associated with higher growth.

In contrast, services received in the forms of special instruction differentiate high from low growth in grades 1 through 4 for the entire sample with a negative relationship. As explained previously in Chapter 6, the policy of providing special instruction primarily to students with special educational need may largely explain the unfavorable finding here. When only CE students are considered, the negative relationship between amount of special instruction and growth remains statistically significant in grades 2 and 3. This finding might be construed by many as a confirmation of their suspicions that employment of special teachers and aides, and emphasis of very small classes (1-6) in the instructional programs for CE students (see Report 5) are not really effective in raising their achievement. It has been suggested, for example, that these types of instruction are not as promising as the services offered by regular classroom teachers, particularly because special teachers could have been hired with lower qualifications than regular teachers. However, our analyses presented in Chapter 3 did not support the speculation that special teachers are less qualified (see Table C1-6 of Appendix C).

Among other aspects of the educational process, only the finding concerning teacher experience is consistent between the samples: students taught by more experienced teachers tend to achieve greater growth. Additionally, in grades 1 to 3, we find a positive relationship between school CE concentration and student achievement gain (after controlling for other differences among students) regardless of which sample is used in the analysis. Findings for all other variables are quite different between the two samples, and at the same time are not subject to clear interpretations.

In general, fewer variables prove to be useful in differentiating the 'successful' CE students from the 'unsuccessful' ones than in discriminating the two groups of high-growth and low-growth students in the entire sample. This result is expected largely because the sample of CE students is considerably smaller. However, in every grade, both the canonical correlation and percent of correct classification are noticeably larger for the analysis that examines only CE students than for the general analysis that examines all students. The reader is reminded that slightly different grouping procedures are used in the two analyses; but in either case, members of the 'high' growth group achieve substantially greater gains than those of the 'low' growth group. Additionally, the amount of variation of the discriminating variables in the sample and the number of discriminators used could also influence these statistics. When the same set of discriminators is used (as in the case when all 28 potential discriminators are used), we find the same differences in these statistics between the two samples.

Table 8-6

Effective Discriminating Variables That Differentiate 'High' From 'Low' Growth and the Directions of Their Effects in the Analyses Using the Entire Sample and the Sample of CE Students, for Reading and Math by Grade†

Effective Discriminating Variables	Reading by Grade						Math by Grade					
	1	2	3	4	5	6	1	2	3	4	5	6
Regular Instruction	+	+*			+*	+*	+*	+*	+*	+*	+	+*
Special Instruction	-*	-	-	-*				-*	-**	+*		
Tutor/Independent Work	+	+	+			+	+		+*	+*	+	+*
Staff/Student Ratio	-*				-							
Support/Teaching Personnel Ratio	-*	-*			-**	-*	-*			+**		-*
Years of Teaching	+	+	+	+		+		+*		+	+*	+*
Highest Degree Earned		+*				-*						
Recent Inservice Training	+**	-*				+*	+*				+**	
Belief in Schooling							+*					-*
Attitude to School Programs	+*		-*				+*	+			+*	+*
School's Minority Concentration	+*	-			+**			-*		+*		-*
School's Poverty Concentration									+*		+**	
School's CE Concentration	+	+	+	+**	+*	+*	+	+				+**
School's Low-Achiever Concentration	-*	-*	-	-**	-	-*	-*	-	-*	-*	-	
School's Central Resources	+**			+**			+					
Parent/Community Involvement		+*					-**		-**	-*	+*	
District Control of Instruction		+**		-**								
Principal's Instructional Leadership			-**						-			-**
Teacher's Involvement in Decisions							-*	-**		-*		
Disturbance of Instruction	+*			-*	-		-**	+*		-*	-	-*
District's Percent of Administrative Staff		-	+*	-**			+*			-*	-*	
Effort in Curriculum Development							+**			+*		
Effort in Planning and Evaluation	+**		+		+**	+*						
Teacher's Use of Lesson Plans		-*				+					+	+*
Frequency of Feedback per Semester	-*			+*	+*					+*	+	+*
Weekly Homework Assigned	+*			-*			+*	+*				+*
Monthly Use of Materials	+	+*					+**	+**		-*		
Individualization of Instruction					-*		+*			-*		+*
Monthly Use of Audio-Visual Equipment							-	-**				
Classroom Achievement Level	+											
Class Size											+*	+*

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†The results of the analyses using the entire sample were extracted from Tables 7-3 and 7-4, and the results of the analyses for CE students only were extracted from Tables 8-5 and 8-7, for reading and math, respectively. '+' and '-' indicate positive and negative, respectively, associations with 'high' growth. Pretest achievement quartile and CE status were excluded from this tabulation.

*Selected only in the analyses for the entire sample.

**Selected only in the analyses for CE students.

No asterisks indicate that the variable is selected in both analyses.

In summary, the present analyses confirmed some of the earlier findings in Chapters 6 and 7. Among the educational variables, teacher experience is the most likely to contribute to the explanation of differences in achievement growth. In addition, concentration of CE students and concentration of low-achieving students in the school are also frequently related to achievement growth. With regard to instructional services, amount of time spent working with tutors or independently is positively related to achievement growth. However, no clear picture emerges as to what characteristics of the educational program are particularly effective in improving reading achievement of CE students. There is little evidence that some educational methods promote the achievement of CE students but not that of other students. This conclusion is in agreement with the lack of evidence for the interaction effects between the educational process and student CE status (see the previous section of this chapter).

Results of the Analyses for Math. Table 8-7 presents the summary statistics and discriminant functions for math. Inspection of the bottom two sections of this table reveals small reductions in the canonical correlations and the percentages of correct classification (ranging from 0.9 to 4.0 percent) as a result of the elimination of some of the 30 potential discriminators by the stepwise procedure. Unlike in reading, the canonical correlation and percent of correct classification do not decrease sharply in the upper grades.

Examining the discriminant functions, we find that Title I participation is a useful discriminator between the 'high' and 'low' growth groups in grades 1, 3, and 4. In these grades, Title I students are more likely to belong to the high-growth group than other CE students, attesting to the success of Title I programs. Instructional services in general are not important in explaining the differences between the two groups of CE students.

Among other characteristics of the educational process, only School's CE Concentration shows significant discriminating power in more than two grades (in grades 1, 2, and 6). The importance of this variable in the distinction between high and low growth was also observed in reading at the first two grades. Additionally, in grades 1 and 2, more use of materials is associated with 'high' growth, while more frequent use of audio-visual equipment is related to 'lower' growth. Four other variables indicate negative relationships with math achievement growth: School's Low-Achiever Concentration (grades 2 and 5), Parent/Community Involvement (grades 1 and 3), Principal's Instructional Leadership (grades 2 and 6), and Disturbance of Instruction (grades 1 and 5). The remaining variables, if selected, contribute significantly to the distinction between groups in a single grade. The fact that these significant relationships are found in different grades without some regularity makes it difficult to decipher their implications.

The second part of Table 8-6 presents a summary of the results from the discriminant analyses for math using the general sample of all students (Table 7-4 in Chapter 7) and those using the restricted sample of CE students only (Table 8-7). These summary data are examined in order to determine if there are any characteristics of educational programs that are specifically effective for differentiating math achievement growth among CE students.

In general, the two sets of educational process variables selected to discriminate the two growth groups differ considerably between the analyses using the two different samples. More variables are found significant in the general sample than in the sample of CE students, again partially because of larger sample sizes. Out of a total of 66 significances observed in the two samples, 41 apply to the general sample but not to the sample of CE students, 13 apply to CE students but not the general sample, and only 12 apply to both samples.

Among the significant discriminators in the sample of CE students, the variables generally do not play a specifically important role in the differentiation between high and low achievement growth for the CE students alone. Nevertheless, in two rare cases, the variables appear to be effective for the discrimination only in the sample of CE students: in grades 1 and 3, Parent/Community Involvement tends to be related to 'low' growth, while in grades 1 and 2, monthly use of materials is favorably connected with 'high' growth. In these instances, the variables are not selected as useful

Table 8-7

Stepwise Two-Group ('High' vs. 'Low' Fall-to-Spring Growth) Discriminant Analyses for Examining the Effect of Instructional Services Received, and Characteristics of Educational Process on the Math Achievement Growth of CE Students*

Discriminating Variables Selected by the Stepwise Discriminant Procedure	Standardized Discriminant Function Coefficients (Beta)											
	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta
Student Characteristics												
Pretest Achievement Quartile	1	-.72	1	-.93	1	-.90	1	-.89	1	-.80	1	-1.00
Participation in Title I Programs	10	.14	NA		4	.20	3	.28	NA		NA	
Instructional Services Received												
Regular Instruction	NA		NA		NA		NA		5	.28	NA	
Special Instruction	NA		NA		5	-.15	NA		NA		NA	
Tutor/Independent Work	4	.17	NA		NA		NA		4	.37	NA	
Characteristics of Educational Process												
Support/Teaching Personnel Ratio	NA		NA		NA		2	.35	NA		NA	
Years of Teaching	NA		NA		NA		4	.19	NA		NA	
Recent Inservice Training	NA		NA		NA		NA		9	.19	NA	
Attitude to School Programs	NA		6	.20	NA		NA		NA		NA	
School's Poverty Concentration	NA		NA		NA		NA		8	.35	NA	
School's CE Concentration	3	.32	3	.32	NA		NA		NA		2	.33
School's Low-Achiever Concentration	NA		4	-.30	NA		NA		6	-.61	NA	
School's Central Resources	8	.22	NA		NA		NA		NA		NA	
Parent/Community Involvement	9	-.23	NA		3	-.20	NA		NA		NA	
Principal's Instructional Leadership	NA		NA		2	-.20	NA		NA		3	-.30
Teacher's Involvement in Decisions	NA		7	-.18	NA		NA		NA		NA	
Disturbance of Instruction	2	-.33	NA		NA		NA		2	-.29	NA	
Effort in Curriculum Development	6	.24	NA		NA		NA		NA		NA	
Teacher's Use of Lesson Plans	NA		NA		NA		NA		3	.19	NA	
Frequency of Feedback per Semester	NA		NA		NA		NA		7	.24	NA	
Monthly Use of Materials	7	.18	5	.22	NA		NA		NA		NA	
Monthly Use of Audio-Visual Equipment	5	-.33	2	-.29	NA		NA		NA		NA	
Statistics for the Discriminant Function												
Mean Discriminant Scores	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
'High' Growth Group	485	.343	371	.350	329	.470	308	.390	309	.375	339	.255
'Low' Growth Group	193	-.861	205	-.633	230	-.672	240	-.501	185	-.626	180	-.481
Wilk's Lambda	.704		.778		.683		.804		.765		.877	
Chi-Square Test Statistics**	235.3		143.2		211.1		118.4		130.8		67.6	
Canonical Correlation (Squared)	.544 (.296)		.471 (.222)		.563 (.317)		.442 (.195)		.485 (.235)		.351 (.123)	
Percent of Correct Classification	76.8		72.2		75.7		70.6		72.5		69.0	
When all 30 Potential Discriminators are used												
Canonical Correlation (Squared)	.574 (.329)		.517 (.267)		.603 (.364)		.522 (.272)		.518 (.268)		.416 (.173)	
Percent of Correct Classification	78.5		76.0		77.6		74.6		75.7		69.9	

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[*] The 'High' and 'Low' growth groups created for this analysis comprise Math CE students whose Fall-to-Spring growth is at least one s.d. above and below respectively, the average for the non-CE students judged to have need for math CE but attending schools that do not provide it. The potential discriminators employed include pretest achievement status, participation in Title I programs, three kinds of instructional services received, and 25 educational-process variables that were found to be effective in predicting posttest scores for at least one of the six grades. The selection criteria of the discriminators in the stepwise procedure are 4.0 for 'F-to-Enter' and 3.9 for 'F-to-Remove'.

[**] Degree of freedom = number of discriminators selected; all chi-squares are significant at the .01 level.

discriminators in the general sample. On the whole, we find few educational process variables that are particularly effective in improving the math achievement of CE students but not in the general sample.

Despite the fewer discriminators used, both the canonical correlations and the percentages of correct classification are substantially larger in the restricted sample of CE students than in the general sample. This is a similar finding as in reading, and the reader may refer to the preceding section for some discussion of its implications.

In summary, few of the educational variables considered prove to be systematically discriminating between math CE students who achieve gains higher than expected and those who achieve gains lower than expected. There is also little agreement between the results of the analyses using two different samples, the sample of all students and that of CE students only. The variables, such as amount of regular instruction, tutor/independent work, years of teaching, teacher attitude to school programs, and school low-achiever concentration, that are associated with achievement growth in the general sample, fail to demonstrate the same discriminating power in the sample of CE students.

Conclusions. The discriminant analysis using the 'high' and 'low' growth CE students did not produce much new information regarding the characteristics of educational programs that are particularly effective in improving achievement. There is no indication that any of the educational aspects we consider has a special relationship with the achievement of CE students that is different from its general relationship with achievement.

SUMMARY AND CONCLUSIONS

In an effort to further our understanding of the nature of the relationship between the characteristics of educational process and achievement, the interaction effects on achievement between the educational process and student characteristics are examined with linear models. We conclude from our analysis that the effects of the educational process do not systematically vary with student characteristics. In general, their relationships with student characteristics are weak and the implications are ambiguous. Most of the interactions involve characteristics of the school's existing conditions (e.g., concentrations of low-achieving students and minorities), which are not easily manipulable. Moreover, these interactions are observed mostly in isolated cases (i.e., in a single grade or subject area); the differences among grades or between reading and math are not clearly interpretable. However, we attempt to offer some possible explanations for each finding so as to benefit future research in the area.

Additionally, the technique of discriminant analyses is applied to help us determine the characteristics of educational programs that may be related to the achievement differences between CE students who achieved gains higher than their comparable non-CE peers and those who achieved lower gains. The analysis, however, could not substantiate the belief that there are some educational aspects that are particularly effective in promoting the achievement of CE students but not that of all elementary students.

In conclusion, the analysis in this chapter does not substantially increase our understanding of how the educational process is related to achievement. We suspect that fruitful results can only be expected when we have pertinent and penetrative data for the educational process. The distal measures obtained through questionnaire survey are unlikely to have direct relationships with achievement. For instance, we do not believe that the amount of homework assigned as reported by the teacher can affect student achievement unless he/she diligently works on it and the homework is appropriate and relevant to learning. We therefore suggest that future study concerning the effects of educational process emphasize frequent classroom observations and in-depth teacher interviews in order to improve our chances of getting valid and proximal measures of educational practices and student learning behaviors. In addition, home interview is necessary to obtain accurate information on student background, home environment, and extra-curricular activities (e.g., approach to homework). Until then, we are not optimistic that our understanding of the achievement process would be improved.

REFERENCES

Afifi, A. and Elashoff, R. M. Missing observations in multivariate statistics, I. Review of the literature. *Journal of the American Statistical Association*, 1966, *61*, 595-604.

Afifi, A. and Elashoff, R. M. Missing observations in multivariate statistics, II. Point estimation in simple linear regression. *Journal of the American Statistical Association*, 1967, *62*, 10-29.

Averch, H. A., Carroll, S. J., Donaldson, T. S., Kiesling, H. J., and Pincus, J. *How Effective is Schooling? A Critical Review and Synthesis of Research Findings*. Santa Monica, California: The Rand Corporation, R-956, 1972.

Barnow, B. S., Cain, G. G., and Goldberger, A. S. *Issues in the Analysis of Selection Bias*. Unpublished manuscript, University of Wisconsin, 1978.

Bentler, P. M. Multivariate Analysis with Latent Variables: Causal Modeling. *Annual Review of Psychology*, 1980, *31*, 419-456.

Bereiter, C. and Engelmann, S. *Teaching Disadvantaged Children in the Preschool*. Englewood Cliffs, N.J.: Prentice-Hall, 1966.

Blake, H. *Class Size: A Summary of Selected Studies in Elementary and Secondary Public Schools*. Unpublished doctoral dissertation, Columbia University, 1954.

Blau, P. M., and Duncan, O. D. *The American Occupational Structure*. New York: Wiley, 1967.

Box, G. E. P., and Tiao, G. C. *Bayesian Inference in Statistical Analysis*. Reading, Mass.: Addison-Wesley, 1973.

Breglio, M. J., Hinckley, R. H., and Beal, R. S. *Students' Economic and Educational Status and Selection for Compensatory Education*. Technical Report No. 2 from the Study of the Sustaining Effects of Compensatory Education on Basic Skills. Santa Ana, Calif.: Decima Research, 1978.

Bryk, A. S., and Weisberg, H. I. Value-added analysis: A dynamic approach to the estimation of treatment effects. *Journal of Educational Statistics*, 1976, *1*, 127-155.

Bryk, A. S., and Weisberg, H. I. Use of the non-equivalent control group design when subjects are growing. *Psychological Bulletin*, 1977, *84*, 950-962.

Bryk, A. S., Strenio, J. F., and Weisberg, H. I. A Method for Estimating Treatment Effects When Individuals are Growing. *Journal of Educational Statistics*, 1980, *5*, 5-34.

Burstein, L. The Role of Levels of Analysis in the Specification of Education Effects. In R. Dreeben, and J. A. Thomas (Eds.), *The Analysis of Educational Productivity, Vol. I: Issues in Microanalysis*. Cambridge, Mass.: Bollinger Publishing, 1980.

Burstein, L. and Knapp, T. R. *The Unit of Analysis in Educational Research*. Technical Report No. 4, Consortium on Methodology for Aggregating Data in Educational Research. Milwaukee, Wisconsin: Vasquez Associates, Ltd., 1975.

Burstein, L., Linn, R., and Capell, F. Analyzing multilevel data in the presence of heterogeneous within-class regressions. *Journal of Educational Statistics*, 1978, *3*, 347-383.

Campbell, D. T. Reforms as Experiments. *American Psychologist*, 1969, *24*, 409-429.

Campbell, D. T. Temporal changes in treatment-effect correlations: A quasi-experimental model for institutional records and longitudinal studies. In G. V. Glass (Ed.), *Proceedings of the 1970 Invitational Conference on Test Problems: The Promise and Perils of Educational Information Systems*. Princeton, N.J.: Educational Testing Service, 1971.

Campbell, D. T. Assignment to Treatment by Priority Scores: The Regression Discontinuity Design. In H. W. Riecken and R. F. Boruch (Eds.), *Social Experimentation: A Method for Planning and Evaluating Social Intervention*. New York: Academic Press, 1974a, 89-96.

Campbell, D. T. *Measurement and Experimentation in Social Settings*. Evanston, Illinois: Northwestern University, 1974b.

Campbell, D. T., and Boruch, R. F. Making the case for randomized assignment to treatments by considering the alternatives: Six ways in which quasi-experimental evaluations in compensatory education tend to underestimate effects. In C. A. Bennett and A. A. Lumsdaine (Eds.), *Evaluation and Experiment: Some Critical Issues in Assessing Social Programs*, New York: Academic Press, 1975.

Campbell, D. T. and Erlebacher, A. How regression artifacts in quasi-experimental evaluation can mistakenly make compensatory education look harmful. In J. Hellmuth (Ed.), *Compensatory Education: A National Debate, Vol. 3, Disadvantaged Child*. New York: Burnner/Mazel, 1970, 185-225.

Campbell, D. T. and Stanley, J. C. *Experimental and Quasi-Experimental Designs for Research*. Chicago, Illinois: Rand McNally, 1966.

Cochran, W. G. The Use of Covariance in Observational Studies. *Journal of the Royal Statistical Society, Series C*, 1969, *18*, 270-275.

Cochran, W. G. Some Effects of Errors of Measurement in Linear Regression. *Proceedings of the Sixth Berkeley Symposium on Mathematical Statistics and Probability (I)*. 1970, 527-539.

Cochran, W. G. and Rubin, D. B. Controlling Bias in Observational Studies: A review: *Sankhya, Series A*, 1973, *35*, 417-446.

Cohen, J. and Cohen P. *Applied Multiple Regression Analysis — Correlational Analysis for Behavioral Sciences*. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1975.

Coleman, J. S. Methods and Results in the IEA Studies of Effects of School on Learning. *Review of Educational Research*, 1975, *45*, 335-386.

Coleman, J. S., Campbell, E. Q., Hobson, C. J., McPartland, J., Mood, A. M., Weinfeld, F. D., and York, R. L. *Equality of Educational Opportunity*. Washington, D.C.: U.S. Department of Health, Education, and Welfare, Office of Education, 1966.

Coles, G. J., and Chalupsky, A. B. *Innovative School Environments and Student Outcomes*. Final Report, Project LONGSTEP, Vol. II. Palo Alto, Calif.: American Institutes for Research, 1976.

Cook, T. D., Appleton, H., Conner, R. F., Shaffer, A., Tamkin, G., and Weber, S. J. *"Sesame Street" Revisited*. New York: Russell Sage, 1975.

Cooley, W. W. Explanatory observational studies. *Educational Researcher*. 1978, *7*, 9-15.

Cooley, W. W., and Leinhardt, G. *Instructional Dimension Study: The Search for Effective Classroom Processes*. Learning Research and Development Center, University of Pittsburgh, 1978.

Coulson, J. E. *Effects of Different Head Start Program Approaches on Children of Different Characteristics: Report on Analysis of Data from 1968-69 National Evaluation*. TM-4862/000/02, Santa Monica, Calif.: System Development Corporation, 1972.

Coulson, J. E., Ozenne, D. G., Bradford, C., Doherty, W. J., Duck, G. A., Hemenway, J. A., and Van Gelder, N. C. *The Second Year of Emergency School Aid Act (ESAA) Implementation*. Santa Monica, Calif.: System Development Corporation, 1976.

Coulson, J. E., Ozenne, D. G., Hanes, S. D., Bradford, C., Doherty, W. J., Duck, G. A., and Hemenway, J. A. *The Third Year of Emergency School Aid Act (ESAA) Implementation*. Santa Monica, Calif.: System Development Corporation, 1977.

Coulson, J. E., Ozenne, D. G., Van Gelder, N. C., Inuzuka, D., Bradford, C., and Doherty, W. J. *The First Year of Emergency School Aid Act (ESAA) Implementation*. Santa Monica, Calif.: System Development Corporation, 1975.

Cronbach, L. J., with the assistance of J. E. Deken and N. Webb. *Research on Classrooms and Schools: Formulation of Questions, Design, and Analysis*. Occasional paper, Stanford Evaluation Consortium, 1976.

Cronbach, L. J., Rogosa, D. R., Floden, R. E., and Price, G. G. *Analysis of Covariance: Angel of Salvation, or Temptress and Deluder*. Occasional paper, Stanford University, Stanford Evaluation Consortium, 1976.

David, J. L., and Pelavin, S. H. *Research on the Effectiveness of Compensatory Education Programs: A Reanalysis of Data*. (SRI Project URU-4425). Menlo Park, Calif.: Stanford Research Institute, 1977.

David, J. L., and Pelavin, S. H. Evaluating Compensatory Education: Over what period of time should achievement be measured? *Journal of Educational Measurement*, 1978, *15*, 91-99.

DeGracie, J. S., and Fuller, W. A. Estimation of the Slope and Analysis of Covariance When the Concomitant Variable is Measured with Error. *Journal of the American Statistical Association*, 1972, *67*, 930-937.

Dougharty, L. A., and Klibanoff, L. S. *An Analysis of the Critical Mass Concept in the Allocation of Compensatory Education Funds*. RMC Report UR-325, Los Angeles, Calif.: RMC Research Corporation, 1977.

Duncan, O. D. Ability and Achievement. *Eugenics Quarterly*, 1968, *15*, 1-11.

Duncan, O. D. *Instruction to Structural Equation Models*. New York: Academic Press, 1975.

Elashoff, J. D. Analysis of Covariance: A Delicate Instrument. *American Educational Research Journal*, 1969, *6*, 383-401.

Federal Reserve Bank of Philadelphia. *What Works in Reading*. Philadelphia, Penn.: School District of Philadelphia, 1979.

Frane, J. W. Some simple procedures for handling missing data for ordered variables in multivariate analysis. *Psychometrika*, 1976, *41*, 409-415.

Gamel, N. N., Tallmadge, G. K., Wood, C. T., and Binkley, J. L. *State ESEA Title I Reports: Review and Analysis of Past Reports, and Development of a Model Reporting System and Format.* (UR-294). Mountain View, Calif.: RMC Research Corporation, 1975.

General Electric Company, TEMPO. *A Survey and Preliminary Analysis in Elementary-Secondary Education: Final Report.* Submitted by G.E. to HEW, 1967.

General Electric Company, TEMPO. *Evaluation of Title I ESEA Compensatory Education.* Santa Barbara, Calif.: General Electric Company-TEMPO, 1971.

Glass, G. V. *Data Analysis of the 1968-69 Survey of Compensatory Education (Title I). Final Report.* Boulder, Colorado: University of Colorado, Laboratory of Educational Research, 1970.

Glass, G. and Smith, M. Meta-Analysis of Research on Class Size and Achievement, *Educational Evaluation and Policy Analysis*, 1979, *1*, 2-16.

Gleason, T. C., and Staelin, R. A proposal for handling missing data. *Psychometrika*, 1975, 40, 229-252.

Glendening, L. *The Effects of Correlated Units of Analysis: Choosing the Appropriate Unit.* Paper presented at the annual Meeting of the American Educational Research Association, San Francisco, 1976.

Goldberger, A. S. *Selection Bias in Evaluating Treatment Effects: Some Formal Illustrations.* University of Wisconsin, Institute for Research on Poverty. Discussion Paper 123-72, 1972.

Guthrie, J. T., Samuels, S. J., Martuza, V., Seifert, M., Tyler, S. J., and Edwall, G. *A Study of the Locus and Nature of Reading Problems in the Elementary School.* Final Report. Newark, Delaware: International Reading Association, 1976.

Haggart, S. A., Kilbanoff, L. S., Sumner, G. C., and Williams, R. S. *Resource Analysis of Compensatory Education.* Technical Report No. 6 from the Study of the Sustaining Effects of Compensatory Education on Basic Skills. Santa Monica, Calif.: System Development Corporation, 1978.

Hanushek, E. The production of education, teacher, quality, and efficiency. In *Do Teachers Make a Difference?* Washington, D.C.: Office of Education, Department of Health, Education, and Welfare, Bureau of Educational Personnel Development, 1970, 79-99.

Heckman, J. J. Dummy Endogenous Variables in a Simultaneous Equation System. *Econometrica*, 1978, 46, 931-959.

Hemenway, J. A., Wang, M., Kenoyer, C. E., Hoepfner, R., Bear, M. B., and Smith, G. *The Measures and Variables in the Sustaining Effects Study.* Technical Report No. 9 from the Study of the Sustaining Effects of Compensatory Education on Basic Skills. Santa Monica, Calif.: System Development Corporation, 1978.

Hinckley, R. H., Beal, R. S., and Breglio, V. J. *Student Economic and Educational Status and Receipt of Educational Services.* Technical Report No. 3 from the Study of the Sustaining Effects of Compensatory Education on Basic Skills, Santa Ana, Calif.: Decima Research, 1978.

Hinckley, R. H. (Ed.), Beal, R. S., Breglio, V. J., Haertel, E. H., and Wiley, D. E. *Student Home Environment, Educational Achievement, and Compensatory Education.* Technical Report No. 4 from the Study of the Sustaining Effects of Compensatory Education on Basic Skills. Santa Ana, Calif.: Decima Research, 1979.

Hocking, R. R. The Analysis and Selection of Variables in Linear Regression. *Biometrics*, 1976, *32*, 1-49.

Hoepfner, R., Zagorski, H., and Wellisch, J. B. *The Sample for the Sustaining Effects Study and Projections of its Characteristics to the National Population*. Technical Report No. 1 from the Study of the Sustaining Effects of Compensatory Education on Basic Skills. Santa Monica, Calif.: System Development Corporation, 1977.

Hogg, R. V. Adaptive Robust Procedures: A partial review and some suggestions for future applications and theory. *Journal of the American Statistical Association*, 1974, 69, 909-926.

Horst, D. P., Tallmadge, G. K., and Wood, C. T. *A Practical Guide to Measuring Project Impact on Student Achievement*. Mountain View, Calif.: RMC Research Corporation, 1975.

Hotelling, H. The Selection of Variates for Use in Prediction with some comments on the General Problem of Nuisance Parameters. *Annals of Mathematical Statistics*, 1940, *11*, 271-283.

Jensen, A. R. How much can we boost IQ and scholastic achievement: *Harvard Educational Review*, 1969, *39*, 1-123.

Jöreskog, K. G. A General Approach to Confirmatory Maximum Likelihood Factor Analysis. *Psychometrika*, 1969, *34*, 183-202.

Jöreskog, K. G. A General Method for Analysis of Covariance Structures. *Biometrika*, 1970, *57*, 239-251.

Jöreskog, K. G. A General Method for Estimating a Linear Structural Equation System. In A. S. Goldberger and O. D. Duncan (Eds.), *Structural Equation Models in the Social Sciences*. New York: Academic Press, 1973.

Jöreskog, K. G. Analyzing Psychological Data by Structural Analysis of Covariance Matrices. In R. C. Atkinson, D. H. Krantz, R. D. Luce, and P. Suppes (Eds.), *Contemporary Developments in Mathematical Psychology*. San Francisco: Freeman, 1974.

Jöreskog, K. G. Structural Analysis of Covariance and Correlation Matrices. *Psychometrika*, 1978, *43*, 443-477.

Jöreskog, K. G., and Goldberger, A. S. Estimation of a Model with Multiple Indicators and Multiple Causes of a Single Latent Variable. *Journal of the American Statistical Association*, 1975, *70*, 631-639.

Jöreskog, K. G., and Sörbom, D. Statistical Models and Methods for Test-Retest Situations. In D. N. M. de Gruijter, and L. J. van der Kamp (Eds.), *Advances in Psychological and Educational Measurement*. New York: Wiley, 1976.

Jöreskog, K. G., and Sörbom, D. Statistical Models and Methods for Analysis of Longitudinal Data. In D. J. Aigner and A. S. Goldberger (Eds.), *Latent Variables in Socioeconomic Models*. Amsterdam: North-Holland, 1977.

Jöreskog, K. G., and Sörbom, D. *LISREL IV, Analysis of Linear Structural Relationships by the Method of Maximum Likelihood. User's Guide*. Chicago, Illinois: National Educational Resources, Inc., 1978.

Kaskowitz, D. H., and Norwood C. R. *A Study of the Norm-Referenced Procedure for Evaluating Project Effectiveness as Applied in the Evaluation of Project Information Packages*. SRI Project URH-3556, Menlo Park, Calif.: Stanford Research Institute, 1977.

Kenny, D. A. A quasi-experimental approach to assessing treatment effects in the non-equivalent control group design. *Psychological Bulletin*, 1975, *82*, 345-362.

Kenoyer, C. E., Cooper, D. M., Saxton, D. E., and Hoepfner, R. R. *The Effects of Discontinuing Compensatory Education Services*. Technical Report No. 11 from the Study of the Sustaining Effects of Compensatory Education on Basic Skills, Santa Monica, Calif.: System Development Corporation, 1981.

Kish, L., and Frankel, M. R. Inference from Complex Samples. *Journal of the Royal Statistical Society, Series B*, 1974, *36*, 1-37.

Klibanoff, L. S., Haggart, S. A., and Steinmetz, R. H. *The Effects and Cost/Effectiveness of Summer School*. Technical Report No. 8 of the Study of the Sustaining Effects of Compensatory Education on Basic Skills. Santa Monica, Calif.: RMC Research Corporation, 1980.

Lindley, D. V. Regression Lines and the Linear Functional Relationship. *Journal of the Royal Statistical Society, Series B*, 1947, *9*, 218-244.

Lindley, D. V. A Statistical Paradox. *Biometrika*, 1957, *44*, 187-192.

Lindley, D. V. The Estimation of Many Parameters. In V. P. Godambe and D. A. Sprott (Eds.)., *Foundations of Statistical Inference*. Toronto: Holt, Rinehart, and Winston, 1971.

Lindley, D. V., and Smith, A. F. M. Bayes Estimates for the Linear Model. *Journal of the Royal Statistical Society, Series B*, 1972, *34*, 1-41.

Linn, R. L., Slinde, J. A. The determination of the significance of change between pre- and posttesting periods. *Review of Educational Research*, 1977, *47*, 121-150.

Linn, R. L. and Werts, C. E. Analysis implications of the choice of a structural model in the nonequivalent control group design. *Psychological Bulletin*, 1977, *31*, 229-234.

Lord, F. M. Test Norms and Sampling Theory. *Journal of Experimental Education*, 1959, *27*, 247-263.

Lord, F. M. Large-Sample Covariance Analysis When the Control Variable is Fallible. *Journal of the American Statistical Association*, 1960, *55*, 307-321.

Lord, F. M. A paradox in the interpretation of group comparisons. *Psychological Bulletin*, 1967, *68*, 304-305.

Lord, F. M., and Novick, M. R. *Statistical Theories of Mental Test Scores*. Reading, Mass.: Addison-Wesley, 1968.

Magidson, J. Toward a causal model approach for adjusting for pre-existing differences in the non-equivalent control group situation. A General Alternative to ANCOVA. *Evaluation Quarterly*, 1977, *1*, 399-420.

McLaughlin, D. H. *Title I, 1965-1975: A Synthesis of the Findings of Federal Studies*. Final Report to NIE under Contract No. 400-76-0129. Palo Alto, Calif.: American Institutes for Research, 1977.

McLaughlin, D. H., Gilmartin, K. J., and Rossi, R. J. *Controversies in the Evaluation of Compensatory Education*. Final Report to NIE under Contract No. 400-76-0129. Palo Alto, Calif.: American Institutes for Research, 1977.

Molitor, J. A., Watkins, M., Napior, D. with Jastrzab, J. J., Brooks, C. L., and Proper, E. C. *Education as Experimentation: A Planned Variation Model, Non-Follow Through Study*. Cambridge, Mass.: Abt Associates, 1977.

Mood, A. M. Partitioning Variance in Multiple Regression Analyses as a Tool for Developing Learning Models. *American Educational Research Journal*, 1971, *8*, 191-201.

Mosteller, F., and Moynihan, D. P. (Eds.). *On Equality of Educational Opportunity*, New York: Vintage Books, 1972.

National Education Association. *Status of the American Public School Teacher, 1975-76*. Washington D.C.: National Education Association, 1977.

National Institute of Education. *Compensatory Education Services*. A Report from the National Institute of Education. Washington, D.C.: U.S. Department of Health, Education, and Welfare, 1977a.

National Institute of Education. *The Effects of Services on Student Development*. A Report from the National Institute of Education. Washington, D.C.: Department of Health, Education, and Welfare, 1977b.

National Institute of Education. *Compensatory Education Study, Final Report to Congress*. Washington, D.C.: The National Institute of Education, U.S. Department of Education, September, 1978.

Neter, J., and Wasserman. W. *Applied Linear Statistical Models — Regression, Analysis of Variance, and Experimental Designs*. Homewood, Illinois: Irwin, Inc., 1974.

Newton, R. G., and Spurrell, D. J. A Development of Multiple Regression for the Analysis of Routine Data. *Applied Statistics*, 1967, *16*, 51-64.

Olsson, U. On the Robustness of Factor Analysis Against Crude Classification of the Observations. *Multivariate Behavioral Research*, 1979, *14*, 485-500.

Overall, J. E., and Woodward, J. A. Nonrandom Assignment and the Analysis of Covariance. *Psychological Bulletin*, 1977a, *84*, 588-594.

Overall, J. E., and Woodward, J. A. Common Misconceptions Concerning the Analysis of Covariance. *Multivariate Behavioral Research*, 1977b, *12*, 171-186.

Peck, R. F., and Tucker, J. A. Research on Teacher Education. In *Second Handbook of Research on Teaching*. Chicago, Illinois: Rand McNally, 1973.

Pelavin, S. H., and David, J. L. *Evaluation Long-term Achievement: An Analysis of Longitudinal Data from Compensatory Education Programs*. Menlo Park, Calif.: Stanford Research Institute, 1977.

Porter, A. C. *The Effects of Using Fallible Variables in the Analysis of Covariance*. Unpublished Doctoral Dissertation, University of Wisconsin, 1967.

Reichardt, C. S. The Statistical Analysis of Data from the Non-Equivalent Control Group Design. In T. D. Cook and D. T. Campbell (Eds.), *The Design and Analysis of Quasi-Experiments in Field Settings*. Chicago, Illinois: Rand McNally, 1979.

Rindskopf, D. M. *A Comparison of Various Regression-Correlation Methods for Evaluating Non-Experimental Research*. Unpublished Doctoral Dissertation, Iowa State University, 1976.

Rindskopf, D., and Wolins, L. *Using Regression/Correlation Methods to Adjust for Pretreatment Differences*. Northwestern University, Division of Evaluation Research and Methodology, 1976.

Rock, F. M., Werts, C. E., and Flaugher, R. L. The Use of Analysis of Covariance Structures for Comparing the Psychometric Properties of Multiple Variables across Populations. *Multivariate Behavioral Research*, 1978, *13*, 408-418.

Roskam, E. E. Multivariate Analysis of Change and Growth: Critical Review and Perspectives. In D. N. de Gruijter and L. J. Van der Kamp (Eds.), *Advances in Psychological and Educational Measurement*. New York: Wiley, 1976, 111-133.

Rossi, R. J., McLaughlin, D. H., Campbell, E. A., and Everett, B. E. *Summaries of Major Title I Evaluations, 1966-1976*. Final Report to NIE under Contract No. 400-76-0129. Palo Alto, Calif.: American Institutes for Research, 1977.

Rubin, D. B. Matching to remove bias in observational studies. *Biometrics*, 1973a, *29*, 159-183.

Rubin, D. B. The use of matched sampling and regression adjustments to remove bias in observational studies. *Biometrics*, 1973b, *29*, 185-203.

Rubin, D. B. Estimating Causal Effects of Treatments in Randomized and Non-Randomized Studies. *Journal of Educational Psychology*, 1974, *66*, 688-701.

Rubin, D. B. Multivariate matching methods that are equal percent bias reducing, I: some examples. *Biometrics*, 1976a, *32*, 109-120.

Rubin, D. B. Multivariate matching methods that are equal percent bias reducing, II: Maximums on Bias Reduction for Fixed Sample Sizes. *Biometrics*, 1976b, *32*, 121-132.

Rubin, D. B. Assignment to treatment group on the basis of a covariate. *Journal of Educational Statistics*, 1977a, *3*, 1-26.

Rubin, D. B. Formalizing Subjective Notions About the Effect of Nonrespondents in Sample Surveys. *Journal of the American Statistical Association*, 1977b, *72*, 538-543.

Rubin, D. B. *Multiple Imputations in Sample Surveys — A Phenomenological Bayesian Approach to Nonresponse*. Paper presented at the August meetings of the American Statistical Association, 1978.

Scriven, M. The methodology of evaluation. In R. W. Tyler, R. Gagné, and M. Scriven (Eds.), *Perspectives on Curriculum Evaluation*. AERA Monograph Series on Curriculum Evaluation, No. 1. Skokie, Illinois: Rand McNally, 1967.

Shapson, S. M., Wright, E. N., Eason, G., and Fitzgerald, J. An Experimental Study of the Effects of Class Size. *American Educational Research Journal*, 1980, *17*, 141-152.

Shavelson, R. J., Hubner, J. J. and Stanton, G. C. Self-Concept: Validation of Construct Interpretations. *Review of Educational Research*, 1976, *46*, 407-441.

Sherwood, C. D., Morris, J. N., and Sherwood, S. A Multivariate, Nonrandomized Matching Technique for Studying the Impact of Social Interventions. In E. L. Struening and M. Guttentag (Eds.), *Handbook of Evaluation Research, Volume I*. Beverly Hills, Calif.: Sage Publications, 1975.

Sörbom, D. Detection of Correlated Errors in Longitudinal Data. *British Journal of Mathematical and Statistical Psychology*, 1975, *28*, 138-151.

Sörbom, D. An Alternative to the Methodology for Analysis of Covariance. *Psychometrika*, 1978, *43*, 381-396.

Sörbom, D., and Joreskog, K. G. *COFAMM, Confirmatory Factor Analysis with Model Modification. User's Guide*. Chicago, Illinois: National Educational Resources, Inc., 1976.

Stake, R. E. The countenance of Educational Evaluation. *Teachers College Record*, 1967, *68*, 523-540.

Summers, A. A., and Wolfe, B. L. Do Schools Make a Difference? *The American Economic Review*, 1977, *67*, 638-652.

Sumner, G. C., Klibanoff, L. S., and Haggart, S. A. *An Analysis of the Cost and Effectiveness of Compensatory Education*. Technical Report No. 7 from the Study of Sustaining Effects of Compensatory Education on Basic Skills. Santa Monica, Calif.: RMC Research Corporation, 1979.

Sween, J. A. *The Experimental Regression Design: An Inquiry into the Feasibility of Nonrandom Treatment Allocation*. Unpublished Doctoral Dissertation, Northwestern University, August, 1971.

Tallmadge, G. K., and Wood, C. T. User's Guide, ESEA Title I Evaluation and Reporting System. Mountain View, Calif.: RMC Research Corporation, 1976.

Tallmadge, G. K., and Wood, C. T. Comparability of Gains From the Three Models in the Title I Evaluation System. Mountain View, Calif.: RMC Research Corporation, 1980.

The SES Project Staff. *A Compilation of the SES Instruments*. Technical Report No. 9A from the Study of the Sustaining Effects of Compensatory Education on Basic Skills. Santa Monica, Calif.: System Development Corporation, 1979.

Thomas, T. C., and Pelavin, S. H. *Patterns in ESEA Title I Reading Achievement*. Menlo Park, Calif.: Stanford Research Institute, 1976.

Timm, N. H. The estimation of variance-covariance and correlation matrices from incomplete data. *Psychometrika*, 1970, *35*, 417-437.

Trismen, D. A., Waller, M. I., and Wilder, G. *A Descriptive and Analytic Study of Compensatory Reading Programs. Final Report, Volume I*. (PR 75-26). Princeton, N.J.: Educational Testing Service, 1975.

Trismen, D. A., Waller, M. I., and Wilder, G. *A Descriptive and Analytic Study of Compensatory Reading Programs. Final Report, Volume II*. (PR 76-3). Princeton, N.J.: Educational Testing Service, 1976.

Tukey, J. W. Causation, Regression, and Path Analysis. In O. K. Kempthorne, T. A. Bancroft, J. W. Gowen, and J. L. Lush (Eds.), *Statistics and Mathematics in Biology*. Ames: Iowa State University Press, 1954.

Tukey, J. W. The future of data analysis. *Annals of Mathematical Statistics*, 1962, *33*, 1-67.

Tukey, J. W. Analyzing data: Sanctification or detective work? *American Psychologist*, 1969, *24*, 83-91.

U.S. General Accounting Office. *Report to the Congress by the Comptroller General of the United States: Assessment of Reading Activities Funded Under the Federal Program of Aid for Educationally Deprived Children*. Office of Education, Department of Health, Education, and Welfare, Report No. MWD-76-54. Washington, D.C.: U.S. General Accounting Office, 1975.

U.S. Office of Education (U.S.O.E.). *A Study of Compensatory Reading Programs: Technical Summary*. Washington, D.C.: U.S. Department of Health, Education, and Welfare, Office of Education, Office of Planning, Budgeting, and Evaluation, Elementary and Secondary Programs Division, 1976.

Wang, M., Hoepfner, R., Zagorski, H., Hemenway, J. A., Brown, D. S., and Bear, M. B. *The Nature and Recipients of Compensatory Education*. Technical Report No. 5 from the Study of the Sustaining Effects of Compensatory Education on Basic Skills, Santa Monica, Calif.: System Development Corporation, 1978.

Wang, M., Novick, M. R., Isaacs, G. L., and Ozenne, D. A Bayesian Data Analysis System for the Evaluation of Social Programs. *Journal of the American Statistical Association*, 1977, *72*, 711-722.

Wargo, M. J., Tallmadge, G. K., Michaels, D. D., Lipe, D., and Morris, S. J. *ESEA Title I: A Reanalysis and Synthesis of Evaluation Data from Fiscal Year 1965 through 1970*. Palo Alto, Calif.: American Institutes for Research, 1972.

Wellisch, J. B., MacQueen, A. H., Carriere, R. A., and Duck, G. A. *Some Policy-Relevant Findings in the ESAA In-depth Studies: Organizational Climate and Equality of Educational Opportunity*. Santa Monica, Calif.: System Development Corporation, TM-5236/023/00, 1977.

Wiley, D. E., and Harnischfeger, A. Explosion of a myth: Quantity of schooling and exposure to instruction, major educational vehicles. *Educational Researcher*, 1974, *3*, 7-13.

Wisler, C. E. *On Partitioning the Explained Variance in a Regression Analyses*. Washington, D.C.: U.S. Office of Education, Technical Note Number 2, 1968.

Woodrow, H. The relation of verbal ability to improvement with practice in verbal tests. *Journal of Educational Psychology*, 1939, *30*, 179-186.

Wright, S. The Method of Path Coefficients. *Annals of Mathematical Statistics*, 1934, *5*, 161-215.

Zagorski, H. J., Jordan, L. A., and Colon, E. J. Attrition of Students in the Sustaining Effects Study. In R. Hoepfner (Ed.), *Supplemental Reports from the Sustaining Effects Study*. Technical Report No. 13 from the Study of the Sustaining Effects of Compensatory Education on Basic Skills. Santa Monica, Calif.: System Development Corporation. 1981.

Zellner, A. *An Introduction to Bayesian Inference in Econometrics*. New York: Wiley, 1971.

APPENDIX A

MATERIALS SUPPORTING CHAPTER 1

A 1 List of Variables Employed in this Report

A 2 Supplementary Tables for Chapter 1

APPENDIX A 1

List of Variables Employed in This Report

Data items and formats for the Report 10 General Analysis File (GAF) are summarized here for analysis references. The 2-4 character prefix for the data item name indicates the instrument from which the data item was obtained, with exceptions of the instructional service items and RMC's resource cost variables. Each of the data items obtained from RMC's resource cost tape is given a name beginning with a character 'C'. Data items showing yearly hours of instructional services attended by the student are given names beginning with a character 'Y'. Data items that were obtained from aggregate statistics have names ending with a character 'S'.

The 'best-level' of CTBS refers to the test level that was selected for administrations in later years and recommended for use in analysis. It varies with schools for a given grade. DBRS is used as an acronym for De-Biased Raw Score, while PRS is used for Publisher's (non-debiased) Raw Score. 'Total' refers to the combined reading and math tests. The prefixes that indicate the source instruments are:

CTBS	Comprehensive Tests of Basic Skills
SAM	Student Affective Measures
PAS	Practical Achievement Scale
SPARM	Student Participation and Attendance Record, Reading and Math
SBC	Student Background Checklist
CER	Compensatory Education Roster
PQ	Principal Questionnaire, Sections A and B
DCH	District Characteristics Questionnaire
DEX	District Expenditure Questionnaire
DQ	District Questionnaires (DCH and DEX)
TQA	Teacher Questionnaire, Section A
TQB	Teacher Questionnaire, Section B (Reading)
TQC	Teacher Questionnaire, Section C (Math)
SAS	Summer Activity Slipsheet

Content and Format of the Data File Employed in Report 10

Description	Data Item Name	Position in the File
School Number (Fall)	SCHOOLF	1-4
Student Number (Fall)	STUDNOF	5-10
School Number (Spring)	SCHOOLS	11-14
Student Number (Spring)	STUDNOS	15-20
Grade	GRADE	21
From STUDA1.CTBS12.RESCORES FILE		
Fall Below-level Indicator	FBELOW1	22
Fall At-level Indicator	FATIND1	23
Fall Best-level Indicator	FBESTI1	24

Description	Data Item Name	Position in the File
Fall Reading Below-level DBRS	CTBS101	25-27
Fall Reading At-level DBRS	CTBS102	28-30
Fall Math Below-level PRS	CTBS103	31-33
Fall Math At-level PRS	CTBS104	34-36
Fall Total Below-level DBRS	CTBS105	37-39
Fall Total At-level DBRS	CTBS106	40-42
CTBS101 Converted to Percentile (Fall Norms)	CTBS107	43-45
CTBS102 Converted to Percentile (Fall Norms)	CTBS108	46-48
CTBS103 Converted to Percentile (Fall Norms)	CTBS109	49-51
CTBS104 Converted to Percentile (Fall Norms)	CTBS110	52-54
CTBS105 Converted to Percentile (Fall Norms)	CTBS111	55-57
CTBS106 Converted to Percentile (Fall Norms)	CTBS112	58-60
CTBS101 Converted to VSS (Vertical Scale Score)	CTBS113	61-63
CTBS102 Converted to VSS	CTBS114	64-66
CTBS103 Converted to VSS	CTBS115	67-69
CTBS104 Converted to VSS	CTBS116	70-72
CTBS105 Converted to VSS	CTBS117	73-75
CTBS106 Converted to VSS	CTBS118	76-78
Fall Reading Best-level DBRS	CTBS119	79-81
Fall Math Best-level PRS	CTBS120	82-84
Fall Total Best-level DBRS	CTBS121	85-87
CTBS119 Converted to Percentile (Fall Norms)	CTBS122	88-90
CTBS120 Converted to Percentile (Fall Norms)	CTBS123	91-93
CTBS121 Converted to Percentile (Fall Norms)	CTBS124	94-96
CTBS119 Converted to VSS	CTBS125	97-99
CTBS120 Converted to VSS	CTBS126	100-102
CTBS121 Converted to VSS	CTBS127	103-105
Spring Below-level Indicator	SBELOW1	106
Spring At-level Indicator	SATIND1	107
Spring Best-level Indicator	SBESTI1	108
Spring Reading Below-level DBRS	CTBS128	109-111
Spring Reading At-level DBRS	CTBS129	112-114
Spring Math Below-level PRS	CTBS130	115-117
Spring Math At-level PRS	CTBS131	118-120
Spring Total Below-level DBRS	CTBS132	121-123
Spring Total At-level DBRS	CTBS133	124-126
CTBS128 Converted to Percentile (Spring Norms)	CTBS134	127-129
CTBS129 Converted to Percentile (Spring Norms)	CTBS135	130-132
CTBS130 Converted to Percentile (Spring Norms)	CTBS136	133-135
CTBS131 Converted to Percentile (Spring Norms)	CTBS137	136-138
CTBS132 Converted to Percentile (Spring Norms)	CTBS138	139-141
CTBS133 Converted to Percentile (Spring Norms)	CTBS139	142-144

Description	Data Item Name	Position in the File
CTBS128 Converted to VSS (Vertical Scale Score)	CTBS140	145-147
CTBS129 Converted to VSS	CTBS141	148-150
CTBS130 Converted to VSS	CTBS142	151-153
CTBS131 Converted to VSS	CTBS143	154-156
CTBS132 Converted to VSS	CTBS144	157-159
CTBS133 Converted to VSS	CTBS145	160-162
Spring Reading Best-level DBRS	CTBS146	163-165
Spring Math Best-level PRS	CTBS147	166-168
Spring Total Best-level DBRS	CTBS148	169-171
CTBS146 Converted to Percentile (Spring Norms)	CTBS149	172-174
CTBS147 Converted to Percentile (Spring Norms)	CTBS150	175-177
CTBS148 Converted to Percentile (Spring Norms)	CTBS151	178-180
CTBS146 Converted to VSS	CTBS152	181-183
CTBS147 Converted to VSS	CTBS153	184-186
CTBS148 Converted to VSS	CTBS154	187-189
From STUDA1.SAMPAS1.SCORES and STUDA1.SAMPAS2.SCORES Files		
Fall Affective Total	SAM001A	190-192
Fall Attitude to Reading	SAM002A	193-195
Fall Attitude to Math	SAM003A	196-198
Fall Attitude to School	SAM004A	199-201
Fall Practical Achievement Score	PAS001A	202-204
Spring Affective Total	SAM001B	205-207
Spring Attitude to Reading	SAM002B	208-210
Spring Attitude to Math	SAM003B	211-213
Spring Attitude to School	SAM004B	214-216
Spring Practical Achievement Score	PAS001B	217-219
From STUDA1.SPARM14.SUMS File		
Weeks Present in 1976-77 School Year	ATTEND	220-222 (F3.1)
Average Hours of Reading Per Week	WEKREAD	223-227 (F5.1)
Total Hours of Reading Offered per Year	READOFF	228-232 (F5.1)
Total Hours of Reading Attended per Year	YEAREAD	233-237 (F5.1)
Hours of Reading per Year, Teacher, 21+ Class	YREADA	238-242 (F5.1)
Hours of Reading Per Year, Teacher, 14-20	YREADB	243-247 (F5.1)
Hours of Reading per Year, Teacher, 7-13	YREADC	248-252 (F5.1)
Hours of Reading per Year, Teacher, 1-6	YREADD	253-257 (F5.1)
Hours of Reading per Year, Special Teacher, 7+	YREADE	258-262 (F5.1)
Hours of Reading per Year, Special Teacher, 1-6	YREADF	263-267 (F5.1)
Hours of Reading per Year, Aide, 1-10	YREADG	268-272 (F5.1)
Hours of Reading per Year, Tutor	YREADH	273-277 (F5.1)
Hours of Reading per Year, Independent, pgm.	YREADI	278-282 (F5.1)
Hours of Reading per Year, Independent, Non-pgm.	YREADJ	283-287 (F5.1)

Description	Data Item Name	Position in the File
Average Hours of Math per Week	WEKMATH	288-292 (F5.1)
Total Hours of Math Offered per Year	MATHOFF	293-297 (F5.1)
Total Hours of Math Attended per Year	YEARMATH	298-302 (F5.1)
Hours of Math per Year, Teacher, 21+ Class	YRMATHA	303-307 (F5.1)
Hours of Math per Year, Teacher, 14-20	YRMATHB	308-312 (F5.1)
Hours of Math per Year, Teacher, 7-13	YRMATHC	313-317 (F5.1)
Hours of Math per Year, Teacher, 1-6	YRMATHD	318-322 (F5.1)
Hours of Math per Year, Special Teacher, 7+	YRMATHE	323-327 (F5.1)
Hours of Math per Year, Special Teacher, 1-6	YRMATHF	328-332 (F5.1)
Hours of Math per Year, Aide, 1-10	YRMATHG	333-337 (F5.1)
Hours of Math per Year, Tutor	YRMATHH	338-342 (F5.1)
Hours of Math per Year, Independent, pgm.	YRMATHI	343-347 (F5.1)
Hours of Math per Year, Independent, non-pgm.	YRMATHJ	348-352 (F5.1)
From STUDA1.SAS1.SCORES File		
Summer Reading Experience	SAS001	353-355
Summer Math Experience	SAS002	356-358
From STUDA1.SBC1.SCORES File		
Sex	SBC004	359
Race/Ethnicity	SBC005	360
Free or Reduced-Price Lunch	SBC007	361
CE Reading, 1975-76	SBC008A	362
CE Reading, 1976-77	SBC008B	363
CE Math, 1975-76	SBC008C	364
CE Math, 1976-77	SBC008D	365
Guidance and Counseling, 1976-77	SBC008F	366
Health and Nutrition, 1976-77	SBC008H	367
Teacher Judgment of CE Need	SBC011	368
Class Reading Level	SBC012	369
Class Math Level	SBC013	370
Mother's Education	SBC015A	371
Father's Education	SBC015B	372
Other Language Spoken in Home	SBC016	373
Early Childhood Experience	SBC020	374
Total Parental Involvement	SBC021	375-376
From STUDA1.CER1.SCORES File		
Sum of CER Reading	CER002	377
Sum of CER Math	CER003	378
Reading CE Selection Status, 1976-77	CER014	379
Math CE Selection Status, 1976-77	CER015	380
Student's Total CE Reading Expenditure (Prorated)	CER027	381-383 (F3.0)
Student's Total CE Math Expenditure (Prorated)	CER028	384-386 (F3.0)

Description	Data Item Name	Position in the File
From Aggregate Statistics for SBC, CER, CTBS Variables		
Percent Minority Enrollment in School (Non-White)	SBC005S	387-389 (F3.0)
Percent Free-Lunch Participants in School	SBC007S	390-392 (F3.0)
Percent Other Language Spoken in Home	SBC016S	393-395 (F3.0)
Percent Reading CE Students in School	CER002S	396-398 (F3.0)
Percent Math CE Students in School	CER003S	399-401 (F3.0)
Percent Reading Below-34%ile (Fall, Best-level)	RLACHS	402-404 (F3.0)
Percent Math Below-34%ile (Fall, Best-level)	MLACHS	405-407 (F3.0)
From 1975-76 Principal Survey (File SCHLS0.PSQ1.EDIT)		
Geographic Region	REGION	408
Size Code of LEA	LEASIZE	409
Poverty Code of LEA	LEAPOV	410
School Urbanism (Recoded into 7 Categories)	LOCATION	411
From RMC.RESCOST.STUDA1.TR7.RESPGM.$\frac{\text{READ}}{\text{MATH}}$ Files		
Total Reading Program Cost	CREAD	412-418 (F7.2)
Reading Pgm. Component Cost, Teacher, 21+ Class	CREADA	419-425 (F7.2)
Reading Pgm. Component Cost, Teacher, 14-20	CREADB	426-432 (F7.2)
Reading Pgm. Component Cost, Teacher, 7-13	CREADC	433-439 (F7.2)
Reading Pgm. Component Cost, Teacher, 1-6	CREADD	440-446 (F7.2)
Reading Pgm. Component Cost, Special Teacher, 7+	CREADE	447-453 (F7.2)
Reading Pgm. Component Cost, Special Teacher, 1-6	CREADF	454-460 (F7.2)
Reading Pgm. Component Cost, Aide, 1-10	CREADG	461-467 (F7.2)
Reading Pgm. Component Cost, Tutor	CREADH	468-474 (F7.2)
Reading Pgm. Component Cost, Independent, Pgm.	CREADI	475-481 (F7.2)
Reading Pgm. Component Cost, Indep. Non-pgm.	CREADJ	482-488 (F7.2)
Total Math Program Cost	CMATH	489-495 (F7.2)
Math Pgm. Component Cost, Teacher, 21+ Class	CMATHA	496-502 (F7.2)
Math Pgm. Component Cost, Teacher, 14-20	CMATHB	503-509 (F7.2)
Math Pgm. Component Cost, Teacher, 7-13	CMATHC	510-516 (F7.2)
Math Pgm. Component Cost, Teacher, 1-6	CMATHD	517-523 (F7.2)
Math Pgm. Component Cost, Special Teacher, 7+	CMATHE	524-530 (F7.2)
Math Pgm. Component Cost, Special Teacher, 1-6	CMATHF	531-537 (F7.2)
Math Pgm. Component Cost, Aide, 1-10	CMATHG	538-544 (F7.2)
Math Pgm. Component Cost, Tutor	CMATHH	545-551 (F7.2)
Math Pgm. Component Cost, Independent, Pgm.	CMATHI	552-558 (F7.2)
Math Pgm. Component Cost, Independent, Non-pgm.	CMATHJ	559-565 (F7.2)
From SCHLA1.PQ1.SCORES File		
School Facilities (Categorical, Recode Required)	PQB001	566
Days in School Session, 1976-77 (Categorical)	PQB003	567
School Grade Span (Categorical)	PQ036	568
Staff/Student Ratio	PQ037	569-570 (F2.2)
Support/Teaching Personnel Ratio	PQ038	571-574 (F4.2)
Student Mobility Rate	PQ039	575-577 (F3.1)
Parent/Community Involvement (Composite)	PQ041	578-579 (F2.0)

Description	Data Item Name	Position in the File
District Control of Instruction	PQ043	580-581 (F2.0)
Principal's Instructional Leadership	PQ044	582-583 (F2.0)
Teacher Involvement in Decision Making	PQ045	584-585 (F2.0)
Disturbance of Instruction	PQ050	586-588 (F3.0)
Ability Grouping	PQ051	589-590 (F2.0)
From SCHLA1.DQ1.SCORES File		
District Has No Testing Pgm. or No Results Report	DCHA004A	591
School ADA (Size Indicator)	DEXB001A	592-595 (F4.0)
School's Current Per-pupil Expenditure	DEXB001C	596-599 (F4.0)
District's Percent of Administrative Staff	DQ001	600-601 (F2.0)
From TCHRA1.TQA1.SCORES File		
Reading Teachers'		
Years of Teaching	TQA001R	602-603 (F2.0)
Highest Degree Earned	TQA004R	604 (F1.0)
Hours of Reading Inservice Training, Last 3 Yrs.	TQA007R	605-606 (F2.0)
Importance of School Causes for Achievement	TQA012R	607 (F1.0)
Positive Attitude to School Programs (TQA024K)	TQA024R	608-609 (F2.0)
Experience and Training (Composite)	TQA031R	610-611 (F2.0)
Math Teachers'		
Years of Teaching	TQA001M	612-613 (F2.0)
Highest Degree Earned	TQA004M	614 (F1.0)
Hours of Math Inservice Training, Last 3 Yrs.	TQA007M	615-616 (F2.0)
Importance of School Causes for Achievement	TQA012M	617 (F1.0)
Positive Attitude to School Programs	TQA024M	618-619 (F2.0)
Experience and Training (Composite)	TQA031M	620-621 (F2.0)
From TCHRA1.TQB1.SCORES File (Reading Program)		
Size of Reading Class	TQB007	622-623 (F2.0)
Hours per Year for Reading Curriculum Development	TQB008	624-625 (F2.0)
Hours per Yr. for R. Needs Assess., Plan, Eval.	TQB009	626-627 (F2.0)
Use of Lesson Plan in Reading Instruction	TQB010	628 (F1.0)
Freq. per Semester of Total Reading Feedback	TQB015D	629-631 (F3.0)
Hours per Week of Reading Homework assigned	TQB021	632-633 (F2.1)
Freq. per Month of Use of Reading Materials	TQB029	634-636 (F3.0)
Individualized Approach in Reading Instruction	TQB034	637-638 (F2.0)
Freq. per Month of Audio-Visual Exposure in Reading	TQB0356	639-641 (F3.0)

Description	Data Item Name	Position in the File
From TCHRA1.TQC1.SCORES File (Math Program)		
Size of Math Class	TQC006	642-643 (F2.0)
Hours per Year for Math Curriculum Development	TQC007	644-645 (F2.0)
Hours per Yr. for Math Need Assess., Plan, Eval.	TQC008	646-647 (F2.0)
Use of Lesson Plan in Math Instruction	TQC009	648 (F1.0)
Freq. per Semester of Total Math Feedback	TQC014D	649-651 (F3.0)
Hours per Week of Math Homework Assigned	TQC019	652-653 (F2.1)
Freq. per Month of Use of Math Instruc. Materials	TQC026	654-656 (F3.0)
Individualized Approach in Math Instruction	TQC032	657-658 (F2.0)
Freq. per Month of Audio-Visual Exposure in Math	TQC0334	659-661 (F3.0)

APPENDIX A 2

Tables of the Rates of Missing CTBS Scores by Student Characteristics

Table A2-1

Percentages of Students With and Without CTBS Reading Scores for Fall and Spring by School Sample and Race/Ethnicity

CTBS Reading Scores Available	Students in Entire Sample					Students in Representative Sample					Students in Comparison Sample					Students in Nominated Sample				
	White	Spanish Heritage	Black	Other	Total	White	Spanish Heritage	Black	Other	Total	White	Spanish Heritage	Black	Other	Total	White	Spanish Heritage	Black	Other	Total
Grade 1																				
Fall & Spring	83.8	74.6	82.2	81.4	82.5	84.3	73.2	82.1	78.4	82.8	80.7	73.0	80.3	75.9	79.8	82.8	78.8	83.0	87.9	82.8
Fall Only	8.8	12.9	9.4	9.0	9.3	8.6	14.2	9.6	10.9	9.3	10.9	11.6	8.5	17.2	10.1	8.7	9.4	9.4	4.4	8.9
Spring Only	7.4	12.3	8.3	9.4	8.1	7.1	12.4	8.2	10.6	7.8	8.3	15.3	11.2	6.9	10.0	8.4	11.5	7.2	7.1	8.0
Neither Time	0.1	0.2	0.2	0.2	0.1	0.1	0.3	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.3	0.4	0.5	0.3
N*	12,853	1,698	5,316	542	20,409	10,186	1,140	2,609	329	14,264	1,115	189	813	29	2,146	1,434	339	1,762	182	3,717
Grade 2																				
Fall & Spring	85.7	77.2	82.1	84.4	84.0	86.5	76.8	81.1	83.7	84.7	82.6	76.3	80.2	88.0	81.3	82.6	82.9	84.8	84.7	83.8
Fall Only	7.7	13.1	9.0	7.2	8.4	7.2	13.7	9.8	6.9	8.2	9.0	7.2	6.8	4.0	7.9	9.8	9.7	8.8	8.3	9.2
Spring Only	6.6	9.3	8.8	8.4	7.5	6.3	9.1	9.0	9.3	7.1	8.4	16.5	12.8	8.0	10.8	7.6	7.1	6.2	7.0	6.9
Neither Time	0.0	0.3	0.1	0.0	0.1	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.4	0.2	0.0	0.1
N*	11,660	1,520	4,704	475	18,359	9,169	1,087	2,175	289	12,720	1,014	139	794	25	1,972	1,364	269	1,603	157	3,393
Grade 3																				
Fall & Spring	86.5	77.5	84.1	82.2	85.0	87.0	76.6	84.5	84.8	85.6	83.2	76.9	80.7	60.9	81.4	85.2	80.0	85.0	83.0	84.5
Fall Only	6.9	12.7	8.3	6.8	7.8	6.5	13.8	8.2	5.3	7.4	9.2	8.8	7.6	17.4	8.6	8.4	11.1	8.8	7.6	8.8
Spring Only	6.5	9.3	7.5	11.0	7.1	6.4	9.3	7.2	9.8	6.9	7.6	14.3	11.7	21.7	10.0	6.4	7.5	6.1	9.4	6.5
Neither Time	0.1	0.4	0.1	0.0	0.1	0.1	0.3	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	1.3	0.1	0.0	0.2
N*	11,272	1,585	4,726	444	18,027	9,029	1,117	2,207	244	12,597	895	147	778	23	1,843	1,240	305	1,622	171	3,338
Grade 4																				
Fall & Spring	87.8	78.8	85.4	82.0	86.3	88.4	77.2	83.9	80.4	86.5	85.6	77.7	83.8	75.0	84.1	83.2	83.7	88.3	86.5	85.6
Fall Only	6.6	11.7	7.9	9.3	7.4	6.2	12.8	9.3	9.2	7.4	8.5	8.6	6.8	18.8	8.0	9.0	10.5	6.4	7.7	7.9
Spring Only	5.5	9.2	6.5	8.7	6.2	5.3	9.8	6.7	10.3	6.0	5.9	13.7	9.3	6.3	7.9	7.8	5.8	5.1	5.8	6.3
Neither Time	0.1	0.2	0.1	0.0	0.1	0.1	0.3	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.2	0.0	0.1
N*	11,379	1,515	4,412	461	17,767	8,794	1,073	2,143	271	12,281	930	139	820	32	1,921	1,251	257	1,253	155	2,916
Grade 5																				
Fall & Spring	88.7	80.8	88.1	85.9	87.7	89.2	78.0	87.3	88.1	87.9	86.7	84.1	90.1	80.8	87.7	84.5	83.8	88.0	84.9	86.1
Fall Only	6.2	10.2	6.8	7.1	6.7	5.9	11.4	7.1	6.9	6.6	7.8	9.4	5.1	11.5	7.0	7.7	10.0	7.1	5.0	7.5
Spring Only	5.1	8.6	5.0	6.9	5.4	4.8	10.0	5.5	5.0	5.3	5.5	6.5	4.7	7.7	5.3	7.6	6.2	4.8	10.1	6.3
Neither Time	0.1	0.4	0.1	0.0	0.1	0.0	0.6	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.2	0.0	0.1
N*	11,546	1,689	4,636	518	18,389	8,968	1,029	2,230	303	12,530	949	138	684	26	1,797	970	260	1,270	159	2,659
Grade 6																				
Fall & Spring	90.1	85.3	89.7	90.5	89.6	90.8	84.3	89.8	89.1	90.2	87.8	85.7	90.4	90.0	88.8	85.3	86.8	89.3	94.8	88.2
Fall Only	5.6	8.8	5.5	5.6	5.9	5.3	9.6	5.3	6.8	5.7	5.8	7.1	5.1	10.0	5.6	7.8	10.4	5.8	1.3	6.5
Spring Only	4.4	5.4	4.7	3.8	4.5	3.8	5.5	4.9	3.8	4.1	6.3	7.1	4.6	0.0	5.6	6.9	2.8	4.6	3.9	5.2
Neither Time	0.0	0.5	0.1	0.2	0.1	0.0	0.7	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1
N*	14,209	1,814	4,236	556	20,815	11,398	1,054	1,963	336	14,753	855	56	592	20	1,523	769	144	1,192	155	2,260

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[*] The small number of students in the Feeder Schools have not been tabulated here. Thus, the N's for the Representative, Comparison, and Nominated Schools do not add to that for the entire sample.

Table A2-2

Percentages of Students With and Without CTBS Math Scores for Fall and Spring by School Sample and Race/Ethnicity

CTBS Math Scores Available	Students in Entire Sample					Students in Representative Sample					Students in Comparison Sample					Students in Nominated Sample				
	White	Spanish Heritage	Black	Other	Total	White	Spanish Heritage	Black	Other	Total	White	Spanish Heritage	Black	Other	Total	White	Spanish Heritage	Black	Other	Total
Grade 1																				
Fall & Spring	83.7	73.9	82.0	81.2	82.4	84.2	72.3	81.9	77.8	82.7	80.7	72.5	79.7	75.9	79.5	82.4	78.8	83.0	88.5	82.6
Fall Only	8.8	13.3	9.4	9.4	9.4	8.6	14.8	9.3	11.2	9.3	10.8	12.2	9.5	17.2	10.5	9.0	8.8	9.5	4.9	9.0
Spring Only	7.4	12.4	8.2	9.4	8.1	7.2	12.6	8.3	10.9	7.9	8.4	14.8	10.7	6.9	9.8	8.4	11.5	7.2	6.6	8.0
Neither Time	0.1	0.4	0.4	0.0	0.2	0.1	0.3	0.5	0.0	0.2	0.1	0.5	0.1	0.0	0.1	0.2	0.9	0.3	0.0	0.3
N*	12,853	1,698	5,316	542	20,409	10,186	1,140	2,609	329	14,264	1,115	189	813	29	2,146	1,434	339	1,762	182	3,717
Grade 2																				
Fall & Spring	85.6	77.0	81.8	84.0	83.9	86.4	76.5	80.9	83.4	84.6	82.5	75.5	80.2	84.0	81.1	82.4	83.3	84.2	84.7	83.4
Fall Only	7.7	13.2	9.0	7.8	8.5	7.2	13.9	9.7	7.6	8.2	8.7	7.2	6.7	8.0	7.8	9.9	9.7	9.1	8.3	9.4
Spring Only	6.7	9.3	8.9	8.2	7.5	6.3	9.1	9.0	9.0	7.1	8.8	17.3	12.8	8.0	11.0	7.6	6.7	6.4	7.0	7.0
Neither Time	0.1	0.4	0.3	0.0	0.2	0.1	0.5	0.4	0.0	0.2	0.0	0.0	0.3	0.0	0.1	0.1	0.4	0.3	0.0	0.2
N*	11,660	1,520	4,704	475	18,359	9,169	1,087	2,175	289	12,720	1,014	139	794	25	1,972	1,364	269	1,603	157	3,393
Grade 3																				
Fall & Spring	86.4	77.7	84.0	81.5	84.9	86.9	76.8	84.4	83.6	85.5	83.1	76.9	81.6	60.9	81.7	85.2	80.0	84.5	83.0	84.3
Fall Only	7.0	12.5	8.4	7.4	7.9	6.6	13.5	8.3	6.6	7.5	9.3	8.8	7.1	17.4	8.4	8.3	11.1	9.1	7.6	8.9
Spring Only	6.5	9.8	7.3	10.6	7.1	6.4	9.6	7.1	9.4	6.9	7.5	14.3	11.3	21.7	9.8	6.5	8.9	6.0	9.4	6.6
Neither Time	0.1	0.1	0.3	0.5	0.1	0.1	0.1	0.2	0.4	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.4	0.0	0.2
N*	11,272	1,585	4,726	444	18,027	9,029	1,117	2,207	244	12,597	895	147	778	23	1,843	1,240	305	1,622	171	3,338
Grade 4																				
Fall & Spring	87.7	78.6	85.0	82.0	86.1	88.4	76.9	83.0	80.4	86.3	85.4	77.7	83.7	75.0	83.9	83.1	83.7	88.3	86.5	85.6
Fall Only	6.6	12.2	8.2	9.3	7.5	6.1	13.4	9.8	9.2	7.5	8.4	8.6	7.3	18.8	8.1	9.2	10.5	6.2	7.7	8.0
Spring Only	5.6	8.8	6.5	8.7	6.2	5.3	9.5	6.6	10.3	6.0	6.0	12.2	9.0	6.3	7.8	7.7	5.4	5.3	5.8	6.3
Neither Time	0.1	0.3	0.3	0.0	0.2	0.1	0.2	0.5	0.0	0.2	0.2	1.4	0.0	0.0	0.2	0.1	0.4	0.2	0.0	0.1
N*	11,379	1,515	4,412	461	17,767	8,794	1,073	2,143	271	12,281	930	139	820	32	1,921	1,251	257	1,253	155	2,916
Grade 5																				
Fall & Spring	88.6	80.5	87.9	85.9	87.6	89.1	77.8	87.0	88.1	87.8	87.0	83.3	91.1	80.8	88.2	84.5	83.5	87.6	84.9	85.9
Fall Only	6.2	10.8	6.9	6.9	6.8	6.0	12.1	7.3	6.6	6.7	7.3	10.9	4.5	11.5	6.6	7.9	10.0	7.4	5.0	7.7
Spring Only	5.1	8.2	5.1	7.1	5.4	4.8	9.4	5.7	5.3	5.3	5.3	5.8	4.2	7.7	5.0	7.4	6.5	5.0	[illegible]	6.3
Neither Time	0.1	0.5	0.1	0.0	0.1	0.1	0.7	0.1	0.0	0.1	0.4	0.0	0.1	0.0	0.3	0.1	0.0	0.1	0.0	0.1
N*	11,546	1,689	4,636	518	18,389	8,968	1,029	2,230	303	12,530	949	138	684	26	1,797	970	260	1,270	159	2,659
Grade 6																				
Fall & Spring	89.9	84.9	89.5	90.3	89.4	90.7	84.0	89.6	89.6	90.0	87.5	83.9	89.7	90.0	88.2	85.0	86.8	89.4	94.8	88.1
Fall Only	5.6	9.0	5.7	5.6	5.9	5.4	9.7	5.6	6.8	5.8	6.2	7.1	5.6	10.0	6.0	7.8	10.4	5.5	1.3	6.3
Spring Only	4.4	5.9	4.7	3.6	4.5	3.9	6.2	4.8	3.6	4.1	6.3	8.9	4.6	0.0	5.6	7.0	2.8	4.7	3.9	5.3
Neither Time	0.1	0.2	0.1	0.0	0.1	0.1	0.2	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.1	0.1	0.0	0.3	0.0	0.2
N*	14,209	1,814	4,236	556	20,815	11,398	1,054	1,963	338	14,753	855	56	592	20	1,523	769	144	1,192	155	2,260

* The small number of students in the Feeder Schools have not been tabulated here. Thus, the N's for the Representative, Comparison and Nominated Schools do not add to that for the entire sample.

Table A2-3

Percentages of Students With and Without CTBS Reading Scores for Fall and Spring by School Sample and Participation in Free or Reduced-Price Meal Programs*

CTBS Reading Scores Available	Students in Entire Sample			Students in Representative Sample			Students in Comparison Sample			Students in Nominated Sample		
	Non-Participant	Free-Meal Participant	Total	Non-Participant	Free-Meal Participant	Total	Non-Participant	Free-Meal Participant	Total	Non-Participant	Free-Meal Participant	Total
Grade 1												
Fall & Spring	86.4	77.5	82.5	86.8	76.5	82.8	83.9	74.0	79.8	86.2	80.7	82.8
Fall Only	7.1	12.1	9.3	6.9	13.1	9.3	8.9	11.7	10.1	7.0	10.0	8.9
Spring Only	6.4	10.2	8.1	6.3	10.2	7.8	7.0	14.2	10.0	6.7	8.8	8.0
Neither Time	0.0	0.2	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.4	0.3
N	11,599	8,810	20,409	8,798	5,466	14,264	1,252	894	2,146	1,395	2,322	3,717
Grade 2												
Fall & Spring	87.7	79.2	84.0	88.2	79.1	84.7	86.8	73.7	81.3	85.9	82.5	83.8
Fall Only	6.3	11.3	8.4	5.9	11.9	8.2	5.9	10.6	7.9	8.3	9.8	9.2
Spring Only	6.0	9.4	7.5	5.9	8.9	7.1	7.3	15.6	10.8	5.8	7.6	6.9
Neither Time	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.2	0.1
N	10,458	7,901	18,359	7,903	4,817	12,720	1,144	828	1,972	1,264	2,129	3,393
Grade 3												
Fall & Spring	88.2	80.9	85.0	88.7	80.8	85.6	85.2	77.4	81.4	87.9	82.6	84.5
Fall Only	5.6	10.5	7.8	5.2	11.0	7.4	7.9	9.2	8.6	6.8	10.0	8.8
Spring Only	6.1	8.4	7.1	6.1	8.0	6.9	6.9	13.3	10.0	5.2	7.3	6.5
Neither Time	0.1	0.2	0.1	0.1	0.2	0.1	0.0	0.0	0.0	0.2	0.2	0.2
N	9,987	8,040	18,027	7,711	4,886	12,597	934	909	1,843	1,223	2,115	3,338
Grade 4												
Fall & Spring	89.8	81.8	86.3	90.2	80.8	86.5	87.9	79.8	84.1	87.3	84.5	85.6
Fall Only	5.2	10.3	7.4	4.8	11.3	7.4	6.9	9.2	8.0	7.0	8.6	7.9
Spring Only	5.0	7.7	6.2	4.9	7.7	6.0	5.2	10.9	7.9	5.7	6.8	6.3
Neither Time	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1
N	10,036	7,731	17,767	7,456	4,825	12,281	1,015	906	1,921	1,177	1,739	2,916
Grade 5												
Fall & Spring	90.4	84.2	87.7	90.6	83.7	87.9	90.1	84.0	87.7	88.3	84.9	86.1
Fall Only	5.0	9.0	6.7	4.9	9.4	6.6	5.9	8.6	7.0	5.9	8.4	7.5
Spring Only	4.6	6.6	5.4	4.5	6.7	5.3	4.0	7.2	5.3	5.8	6.6	6.3
Neither Time	0.0	0.2	0.1	0.0	0.2	0.1	0.0	0.1	0.1	0.0	0.2	0.1
N	10,375	8,014	18,389	7,681	4,849	12,530	1,076	721	1,797	966	1,693	2,659
Grade 6												
Fall & Spring	91.7	86.0	89.6	92.3	85.6	90.2	91.0	85.9	88.8	90.0	87.2	88.2
Fall Only	4.6	8.0	5.9	4.3	8.6	5.7	5.0	6.5	5.6	5.3	7.1	6.5
Spring Only	3.7	5.8	4.5	3.4	5.6	4.1	4.0	7.5	5.6	4.7	5.5	5.2
Neither Time	0.0	0.2	0.1	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.2	0.1
N	13,092	7,723	20,815	10,162	4,591	14.753	847	676	1,523	811	1,449	2,260

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*The small number of students in the Feeder Schools have not been tabulated here. Thus, the N's for the Representative, Comparison, and Nominated Schools do not add to that for the entire sample.

Table A2-4

Percentages of Students With and Without CTBS Math Scores for Fall and Spring by School Sample and Participation in Free or Reduced-Price Meal Programs*

CTBS Math Scores Available	Students in Entire Sample			Students in Representative Sample			Students in Comparison Sample			Students in Nominated Sample		
	Non-Participant	Free-Meal Participant	Total	Non-Participant	Free-Meal Participant	Total	Non-Participant	Free-Meal Participant	Total	Non-Participant	Free-Meal Participant	Total
Grade 1												
Fall & Spring	86.2	77.3	82.4	86.6	76.3	82.7	83.9	73.5	79.5	85.8	80.7	82.6
Fall Only	7.2	12.2	9.4	6.9	13.1	9.3	9.1	12.4	10.5	7.2	10.1	9.0
Spring Only	6.5	10.2	8.1	6.4	10.2	7.9	7.0	13.8	9.8	6.8	8.7	8.0
Neither Time	0.1	0.4	0.2	0.0	0.4	0.2	0.0	0.3	0.1	0.1	0.4	0.3
N	11,599	8,810	20,409	8,798	5,466	14,264	1,252	894	2,146	1,395	2,322	3,717
Grade 2												
Fall & Spring	87.5	79.0	83.9	88.1	78.8	84.6	86.5	73.8	81.1	85.5	82.2	83.4
Fall Only	6.3	11.3	8.5	5.9	11.9	8.2	6.0	10.1	7.8	8.5	10.0	9.4
Spring Only	6.1	9.4	7.5	6.0	8.9	7.1	7.4	15.9	11.0	5.9	7.6	7.0
Neither Time	0.1	0.3	0.2	0.1	0.3	0.2	0.1	0.1	0.1	0.1	0.3	0.2
N	10,458	7,901	18,359	7,903	4,817	12,720	1,144	828	1,972	1,264	2,129	3,393
Grade 3												
Fall & Spring	88.2	80.7	84.9	88.6	80.6	85.5	85.5	77.8	81.7	88.0	82.1	84.3
Fall Only	5.7	10.6	7.9	5.2	11.2	7.5	7.8	9.0	8.4	6.7	10.2	8.9
Spring Only	6.1	8.4	7.1	6.1	8.0	6.9	6.5	13.2	9.8	5.3	7.3	6.6
Neither Time	0.0	0.2	0.1	0.0	0.2	0.1	0.1	0.0	0.1	0.0	0.3	0.2
N	9,987	8,040	18,027	7,711	4,886	12,597	934	909	1,843	1,223	2,115	3,338
Grade 4												
Fall & Spring	89.6	81.6	86.1	90.0	80.5	86.3	87.7	79.7	83.9	87.2	84.5	85.6
Fall Only	5.2	10.5	7.5	4.9	11.5	7.5	6.7	9.7	8.1	7.0	8.6	8.0
Spring Only	5.1	7.6	6.2	5.1	7.6	6.0	5.5	10.3	7.8	5.8	6.7	6.3
Neither Time	0.1	0.3	0.2	0.1	0.4	0.2	0.1	0.3	0.2	0.1	0.2	0.1
N	10,036	7,731	17,767	7,456	4,825	12,281	1,015	906	1,921	1,177	1,739	2,916
Grade 5												
Fall & Spring	90.3	84.1	87.6	90.4	83.7	87.8	90.6	84.6	88.2	88.2	84.6	85.9
Fall Only	5.0	9.1	6.8	5.0	9.5	6.7	5.2	8.6	6.6	5.9	8.7	7.7
Spring Only	4.6	6.5	5.4	4.5	6.6	5.3	3.8	6.7	5.0	5.9	6.6	6.3
Neither Time	0.1	0.2	0.1	0.1	0.2	0.1	0.4	0.1	0.3	0.0	0.1	0.1
N	10,375	8,014	18,389	7,681	4,849	12,530	1,076	721	1,797	966	1,693	2,659
Grade 6												
Fall & Spring	91.5	85.9	89.4	92.1	85.4	90.0	90.3	85.7	88.2	89.6	87.3	88.1
Fall Only	4.7	8.1	5.9	4.4	8.7	5.8	5.3	7.0	6.0	5.4	6.8	6.3
Spring Only	3.8	5.8	4.5	3.4	5.8	4.1	4.4	7.2	5.6	4.9	5.5	5.3
Neither Time	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.3	0.2
N	13,092	7,723	20,815	10,162	4,591	14,753	847	676	1,523	811	1,449	2,260

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[*] The small number of students in the Feeder Schools have not been tabulated here. Thus, the N's for the Representative, Comparison, and Nominated Schoo do not add to that for the entire sample.

Table A2-5

Percentages of Students With and Without CTBS Reading Scores for Fall and Spring by School Sample and Levels of Mother's Educational Attainment*

CTBS Reading Scores Available	Students in Entire Sample				Students in Representative Sample				Students in Comparison Sample				Students in Nominated Sample			
	Less Than High School	High School Grad	College Grad	Total	Less Than High School	High School Grad	College Grad	Total	Less Than High School	High School Grad	College Grad	Total	Less Than High School	High School Grad	College Grad	Total
Grade 1																
Fall & Spring	78.2	86.6	90.6	84.8	77.0	86.8	90.9	84.9	78.3	83.4	89.5	82.7	81.0	87.9	87.6	85.4
Fall Only	12.0	7.2	5.4	8.2	13.0	6.9	5.3	8.2	11.4	10.2	6.3	10.2	9.4	6.2	6.2	7.3
Spring Only	9.5	6.2	3.9	6.9	9.8	6.2	3.8	6.8	10.3	6.4	4.2	7.0	8.8	5.0	6.2	6.9
Neither Time	0.3	0.1	0.0	0.1	0.2	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.7	0.1	0.0	0.3
N	3,592	9,275	1,218	14,085	2,423	6,781	1,004	10,208	290	1,022	95	1,407	838	1,394	97	2,329
Grade 2																
Fall & Spring	82.1	87.8	92.2	86.8	82.8	88.1	91.6	87.2	80.4	86.5	95.8	86.4	81.6	87.5	94.9	85.8
Fall Only	10.1	6.3	4.2	7.1	9.8	6.2	4.5	6.9	9.8	5.7	1.7	6.0	10.3	6.9	3.1	7.9
Spring Only	7.8	5.9	3.6	6.1	7.4	5.7	3.9	5.9	9.8	7.6	2.5	7.5	8.1	5.5	2.0	6.2
Neither Time	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0
N	3,107	8,511	1,122	12,740	2,102	6,227	888	9,217	194	785	119	1,098	778	1,401	98	2,277
Grade 3																
Fall & Spring	83.5	88.0	91.2	87.1	83.7	88.8	91.3	87.8	80.2	82.6	87.5	82.2	84.3	88.0	91.9	86.9
Fall Only	9.5	6.3	4.7	7.0	9.6	5.7	4.6	6.5	9.5	8.7	6.3	8.8	9.2	7.5	4.0	7.9
Spring Only	6.8	5.7	4.2	5.9	6.6	5.4	4.1	5.6	10.3	8.7	6.3	9.0	6.0	4.5	4.0	5.0
Neither Time	0.2	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.2
N	3,376	8,160	1,154	12,690	2,221	5,975	951	9,147	359	826	80	1,265	750	1,297	99	2,146
Grade 4																
Fall & Spring	84.5	89.1	92.6	88.2	84.3	89.1	92.7	88.3	81.6	88.1	92.2	86.8	85.0	87.9	91.3	87.1
Fall Only	8.1	5.8	4.1	6.3	8.4	5.7	4.0	6.2	9.6	6.2	4.9	7.0	7.3	7.3	5.4	7.2
Spring Only	7.3	5.0	3.2	5.5	7.2	5.1	3.2	5.4	8.9	5.7	2.9	6.3	7.7	4.6	3.3	5.6
Neither Time	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
N	3,357	7,835	1,156	12,348	2,248	5,719	932	8,899	293	737	103	1,133	627	1,119	92	1,838
Grade 5																
Fall & Spring	85.7	90.7	94.3	89.7	85.3	91.2	95.0	90.1	83.6	88.5	92.2	87.6	86.8	89.3	88.6	88.4
Fall Only	8.1	5.0	3.1	5.7	8.5	4.6	2.7	5.4	8.9	6.8	2.0	6.9	6.8	5.7	7.6	6.2
Spring Only	5.9	4.3	2.6	4.6	5.9	4.1	2.2	4.4	7.5	4.6	5.9	5.5	6.2	4.9	3.8	5.3
Neither Time	0.2	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.2	0.1	0.0	0.1
N	3,454	8,350	1,194	12,998	2,398	6,058	948	9,404	280	711	102	1,093	599	1,092	79	1,770
Grade 6																
Fall & Spring	88.1	91.8	94.7	91.1	88.6	92.5	95.1	91.8	83.8	92.7	93.3	90.4	89.4	89.3	89.9	89.4
Fall Only	6.7	4.4	3.4	4.9	7.0	4.0	3.0	4.6	6.2	4.2	2.7	4.6	5.3	6.4	7.2	6.1
Spring Only	5.2	3.8	2.0	4.0	4.3	3.5	1.9	3.5	10.0	3.1	4.0	5.0	5.3	4.3	2.9	4.6
Neither Time	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N	3,784	9,468	1,371	14,623	2,641	6,983	1,103	10,727	260	645	75	980	511	858	69	1,438

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[*] Because teachers were allowed to mark a response alternative 'cannot estimate' in the item about mother's educational attainment, sample sizes in this table are considerably reduced by counting such responses as missing data.

Table A2-6

Percentages of Students With and Without CTBS Math Scores for Fall and Spring by School Sample and Levels of Mother's Educational Attainment*

CTBS Math Scores Available	Students in Entire Sample				Students in Representative Sample				Students in Comparison Sample				Students in Nominated Sample			
	Less Than High School	High School Grad	College Grad	Total	Less Than High School	High School Grad	College Grad	Total	Less Than High School	High School Grad	College Grad	Total	Less Than High School	High School Grad	College Grad	Total
Grade 1																
Fall & Spring	77.9	86.3	90.4	84.5	76.7	86.6	90.8	84.6	77.6	82.8	89.5	82.2	80.9	87.9	85.6	85.3
Fall Only	12.0	7.4	5.5	8.4	13.1	7.0	5.3	8.3	12.1	10.9	6.3	10.8	9.1	6.4	7.2	7.4
Spring Only	9.7	6.3	4.0	6.9	9.9	6.3	3.8	6.9	9.7	6.4	4.2	6.9	9.5	5.7	7.2	7.1
Neither Time	0.4	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.7	0.0	0.0	0.1	0.5	0.0	0.0	0.2
N	3,592	9,275	1,218	14,085	2,423	6,781	1,004	10,208	290	1,022	95	1,407	838	1,394	97	2,329
Grade 2																
Fall & Spring	81.7	87.7	92.1	86.6	82.3	88.0	91.6	87.1	79.9	86.6	95.0	86.3	81.4	87.2	93.9	85.5
Fall Only	10.2	6.4	4.1	7.1	9.9	6.2	4.4	6.9	10.3	5.6	1.7	6.0	10.3	7.3	3.1	8.1
Spring Only	7.8	5.9	3.8	6.2	7.5	5.7	4.1	5.9	9.8	7.8	3.4	7.7	8.1	5.6	3.1	6.3
Neither Time	0.3	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
N	3,107	8,511	1,122	12,740	2,102	6,227	888	9,217	194	785	119	1,098	778	1,401	98	2,277
Grade 3																
Fall & Spring	83.4	87.9	91.2	87.0	83.5	88.7	91.2	87.7	80.8	82.9	88.8	82.7	84.1	87.9	91.9	86.8
Fall Only	9.5	6.3	4.7	7.0	9.7	5.8	4.6	6.6	9.2	8.4	6.3	8.5	9.2	7.5	4.0	7.9
Spring Only	7.0	5.6	4.2	5.9	6.6	5.4	4.2	5.6	10.0	8.6	5.0	8.8	6.7	4.5	4.0	5.2
Neither Time	0.1	0.1	0.0	0.1	0.2	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.2	0.0	0.1
N	3,376	8,160	1,154	12,690	2,221	5,975	951	9,147	359	826	80	1,265	750	1,297	99	2,146
Grade 4																
Fall & Spring	84.3	88.9	92.5	88.0	84.0	88.9	92.6	88.1	81.6	88.2	91.3	86.8	85.2	87.9	91.3	87.2
Fall Only	8.5	5.9	4.2	6.5	8.9	5.8	4.1	6.4	10.2	6.1	4.9	7.1	7.5	7.3	5.4	7.3
Spring Only	7.0	5.1	3.3	5.5	6.9	5.3	3.2	5.5	7.8	5.7	3.9	6.1	7.3	4.6	3.3	5.5
Neither Time	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.3	0.0	0.0	0.1	0.0	0.1	0.0	0.1
N	3,357	7,835	1,156	12,348	2,248	5,719	932	8,899	293	737	103	1,133	627	1,119	92	1,838
Grade 5																
Fall & Spring	85.6	90.6	94.1	89.6	85.1	91.1	94.8	89.9	84.3	89.0	91.2	88.0	87.0	89.3	88.6	88.5
Fall Only	8.4	5.0	3.4	5.8	8.9	4.7	2.8	5.6	8.2	6.3	3.9	6.6	7.0	5.8	7.6	6.3
Spring Only	5.7	4.3	2.6	4.5	5.8	4.2	2.3	4.4	6.8	4.4	4.9	5.0	6.0	4.9	3.8	5.2
Neither Time	0.3	0.1	0.0	0.1	0.3	0.1	0.0	0.1	[illegible]7	0.3	0.0	0.4	0.0	0.1	0.0	0.1
N	3,454	8,350	1,194	12,998	2,398	6,058	948	9,404	[illegible]0	711	102	1,093	599	1,092	79	1,770
Grade 6																
Fall & Spring	87.9	91.6	94.8	90.9	88.3	92.3	95.2	91.6	83.1	92.4	93.3	90.0	89.8	88.8	89.9	89.2
Fall Only	6.7	4.5	3.2	5.0	7.0	4.1	2.9	4.7	6.2	4.2	2.7	4.6	4.5	6.6	7.2	5.9
Spring Only	5.3	3.9	1.9	4.0	4.5	3.6	1.8	3.6	10.8	3.4	4.0	5.4	5.1	4.5	2.9	4.7
Neither Time	0.2	0.0	0.1	0.1	0.2	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.2
N	3,784	9,468	1,371	14,623	2,641	6,983	1,103	10,727	260	645	75	980	511	858	69	1,438

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* Because teachers were allowed to mark a response alternative 'cannot estimate' in the item about mother's educational attainment, sample sizes in this table are considerably reduced by counting such responses as missing data.

APPENDIX B

MATERIALS SUPPORTING CHAPTER 2

B1 Supplementary Text and Tables for Norm-Referenced Analyses

B2 Supplementary Tables for Analyses of Variance

B3 Supplementary Text and Tables for Analyses of Covariance

B4 Supplementary Tables for Comparisons of Gains Conditional on Pretest Scores

B5 Supplementary Text and Tables for Comparisons with Expected Growth

APPENDIX B 1

SUPPLEMENTARY TEXT AND TABLES
FOR NORM-REFERENCED ANALYSES

Two Refined Norm-Referenced Criteria

Two refinements of Criterion A, percentile maintenance, are described below.

1. *Projected mean VSS gain for the group of students with similar fall percentile ranks.* In anticipation of some differential growth among students at different achievement levels, national projections were made for ten subgroups of students, each achieving at a different decile in the fall. The projected means and standard deviations of the VSS gains for the 'recommended-level' test scores are presented in Table B1-1. The projected mean VSS gains for students in the population whose pretest decile scores are equal to those for CE students is used as the criterion. To determine the value of this criterion, the observed pretest mean VSS for the analysis group is converted to a percentile rank P_o using the fall norm and then the projected mean VSS gain for the pretest percentile interval that includes P_o is found from Table B2-1 and used as the criterion.

   As the students were divided into ten achievement groups based on their percentile ranks to compute the projections, some regression effects may be present in the projected gains for each group. However, they are expected to be small because of the large group size and the high test reliabilities. Another problem is that inclusion of CE students in the projection introduced some confounding: the projected gains may be inflated if CE has positive effects. Inspection of our data reveals that this is not a concern.

   Nonetheless, it is important to note that where this is the situation, the mean gain for CE students in that achievement group would still be larger than the projected mean, and if it is substantially larger we would have great confidence that a positive effect will be found. On the other hand, if this is not the situation, whether CE students are included in the projection or not, no positive effect can be found.

   The same contaminating CE effects may also be a concern in the use of norms to set a comparison standard. This contamination is expected to have little influence in our evaluation. The reason is that if CE students achieve considerably better in the spring than non-CE students, the non-CE students with smaller gains would be shuffled down to the lower ranks. Consequently, using the difference in the fall and spring VSSs for a given percentile rank for comparison (e.g., the percentile-maintenance criterion) will properly show a higher gain for CE students. Again, if there are no positive effects of CE, our criteria derived from the norms cannot erroneously show positive effects. Incidentally, this concern of confounding CE effects in the norms is applicable to all other recent norms, as CE programs have been in effect for more than a decade and publishers' standardizations have not been able to exclude CE students either.

Table B1-1

Projected Means and Standard Deviations for VSS Gains by Categories of Pretest Achievement Status*

Pretest (fall) Percentile Rank	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
READING												
1-10	79.1	33.4	59.5	38.4	50.8	37.2	49.5	39.5	43.3	41.5	37.8	40.0
11-20	70.2	36.2	44.7	36.7	32.3	29.4	31.1	34.8	26.6	37.3	28.7	32.0
21-30	65.9	35.6	40.8	33.4	36.0	30.3	25.6	30.1	25.1	32.8	22.0	25.8
31-40	63.2	36.9	43.5	32.1	39.1	27.9	26.7	26.2	27.4	26.1	20.6	22.8
41-50	65.1	32.7	44.3	30.0	38.0	26.8	25.1	26.8	25.0	21.6	23.2	23.7
51-60	64.6	29.9	45.3	28.7	32.3	23.1	30.8	25.0	24.4	21.9	27.8	27.6
61-70	64.2	33.3	49.4	28.2	27.8	24.1	32.1	23.2	24.2	25.3	31.4	31.0
71-80	65.6	36.1	45.9	24.0	28.0	28.7	32.4	27.2	29.3	26.8	34.9	32.0
81-90	66.0	36.9	39.7	26.2	33.3	32.7	25.0	31.3	31.7	32.0	29.2	33.8
91-99	61.6	37.5	28.3	30.1	25.7	35.1	13.8	35.6	20.9	31.4	14.0	28.9
Total	66.7	35.4	43.9	31.9	34.5	30.7	29.2	31.5	27.6	30.7	26.9	30.9
MATH												
1-10	78.3	37.0	75.8	40.9	71.4	43.6	65.9	42.5	58.7	48.2	60.1	50.2
11-20	66.9	33.2	65.6	39.4	64.9	38.6	55.4	39.1	51.6	46.1	46.7	44.1
21-30	62.2	33.2	57.1	37.6	62.0	37.5	53.2	40.9	45.4	42.9	42.1	40.2
31-40	61.4	35.0	61.3	35.5	62.7	35.5	58.8	39.3	48.6	44.3	43.3	44.3
41-50	63.9	33.8	58.2	33.2	62.4	36.3	57.8	39.2	44.4	41.7	37.7	41.9
51-60	62.2	31.0	57.8	32.6	60.4	35.5	56.1	39.3	45.5	40.1	44.9	45.6
61-70	61.6	32.0	55.1	30.8	59.2	36.2	53.6	38.8	42.7	39.5	43.1	45.2
71-80	57.1	33.8	53.7	32.0	57.7	41.1	49.2	38.3	40.9	46.6	48.3	46.4
81-90	58.3	33.2	50.3	32.6	59.9	46.4	41.5	40.1	44.7	43.2	45.1	48.1
91-99	50.5	34.4	43.3	38.3	48.2	45.3	30.5	41.1	35.9	47.2	27.9	44.9
Total	62.4	34.3	57.5	36.3	60.7	40.1	52.2	41.0	45.8	44.4	44.1	45.8

*The projections are based on test scores for the 'recommended level' (see the text of Chapter 1 for an explanation of the test level).

For the benefit of readers who would like to make their own assessment of the extent of confounding CE effects in the norms and the projected mean gains, we note that the largest projected percentages of CE students are always found in the lowest achievement group. These percentages range from 38 to 58 for reading and from 26 to 35 for math. In every grade, the percentages decrease rapidly with pretest achievement level and drop down to less than 20 percent in most cases at the median level.

2. *VSS gain required to maintain a percentile rank that is the midpoint of the 'decile' associated with the mean fall VSS for the group.* This criterion is similar to the first criterion except that the midpoint of the 'tenth' in the pretest distribution that covers the group's average percentile ranks, P_o, is employed as the reference percentile. As an illustration, consider an analysis group for which P_o is 23. The 'tenth' containing P_o is then the percentile interval 21-30, and thus the reference percentile becomes 25. This criterion is adopted to provide a check for the stability of the 'percentile-maintenance' criterion against estimation errors for P_o.

When the achievement growth is examined for all CE students combined (as in Table 2-1), values for the first criterion are 66, 41, 34, 26, 26, and 25 for reading; and 62, 57, 62, 53, 45, and 42 for math. The values for the second criterion are 55, 40, 34, 32, 39, and 31 for reading, and 54, 52, 57, 49, 40, and 41 for math.

Based on the data in Table 2-1, for the first grade, Criterion 1 is considerably more stringent than others and represents the only criterion that is not satisfied. This observation applies to both reading and math, and could partly be a consequence of the lower test reliabilities at this grade and thus larger regression effects. On the other hand, this criterion is less stringent than most others for reading at grade 4, the only positive finding obtained among the criteria. The results for the second criterion agree with those for the 'percentile-maintenance' criterion with only one exception. For reading at grade 4, an ambiguous bit of evidence is found for the latter instead of the no evidence for the former. The parallel findings between the second criterion and the percentile-maintenance criterion indicate some stability for the equipercentile growth criterion within a range of percentile rank. Because these two refined criteria provide either conflicting information (criterion 1) or merely replication (criterion 2), we will not discuss them further in this Appendix.

Norm-Referenced Analyses by Demographic Characteristics of Schools

Tables B1-2 through B1-6 present the results of the norm-referenced analyses by demographic characteristics of schools. These analyses implement the norm-referenced standards on a group basis (see Chapter 2 for an explanation of how to set this criterion). The results of the corresponding norm-referenced analyses that implement the standards on an individual basis (to be explained in a subsequent section) are provided in Tables B1-9 through B1-13. The findings in the two sets of analyses are similar, so we will discuss only the results for the group-level analyses.

Tables B1-2 and B1-3 present the results for the analyses by geographic region and by urbanism, respectively. The Northeast represents New England, Metropolitan Northeast, and Mid-Atlantic of the ten Federal regions. The North Central comprises the North Midwest, Central Midwest, and North Central regions. The Northwest region is simply the Pacific Northwest in the Federal demarcations. The South includes the Southeast, South Central, and Pacific Southwest regions. For reference, see Figure 2-1 of Report 5. The degree of urbanism for the schools was defined in terms of school's locale. The category 'city' includes all schools located in cities with populations greater than 50,000. The category 'suburb or small city' refers to schools in suburbs or cities with populations less than 50,000. The 'rural' category consists of all schools in rural areas.

The major findings from these two tables are:

- In reading, positive results are observed for grade 3, except in the Northeast region. Referring to Table 2-3, this exception could possibly be a result of more other-CE students and higher pretest scores for CE students in the Northeast, compared with other regions.

- In math, the analyses with the percentile-maintenance criterion show positive effects of CE in grades 1 and 4 in the South, in grades 4 and 5 in the Northwest, and in grade 1 in the Northeast. In all other analyses, few positive results are obtained.

These findings suggest that divisions into homogeneous regions with respect to concentrations of low-achieving students do not enhance the chances for detecting positive effects of CE.

- While there is little evidence for positive effects in the overall analysis for grade 5 in reading, a positive finding is obtained for rural areas in this case. Positive effects are also obtained for rural areas in grade 2 in reading. Except for sampling differences, we are not aware of a good explanation for these specific findings.

- In math, analyses with the percentile-maintenance criterion produce positive results for cities but not for rural areas at grades 1, 2, and 4. This finding may be an indication of greater emphasis on math CE in cities than in rural areas. However, the higher pretest mean for CE students in rural areas could in part explain the results, considering regression effects.

As in the analyses by regions, subset analyses by urbanism fail to reveal a better picture of CE effects than in the overall analyses.

Tables B1-4 and B1-5 display the results for analyses by school's concentrations of minority and poverty students, and by school's concentration of low-achieving students, respectively. The concentration of poverty students is defined in terms of the percentage of students participating in free-meal programs. The low-achieving students refer to those scoring at or below the 33rd percentile rank at the pretest time, and are determined for reading and math separately. Some highlights of the findings in these two sets of analyses are:

- In reading, positive effects are detected in the subset of schools with high concentrations of minority and poverty students at grades 1 and 3. In contrast, schools with low concentrations of poverty students, regardless of their concentrations of minority students, tend to show positive effects of CE in grade 2. Such inconsistent results among grades makes it difficult to generalize the findings in these respects.

- In math, there are slight positive effects in schools with high concentrations of minority and poverty students (at grades 1, 2, 4, and 5). This result may, however, partly be a reflection of the large sample sizes for this group of CE students.

- In reading, positive effects of CE are observed primarily in schools with high concentrations of low achievers at grades 1 and 3. This finding is consistent with an earlier one showing positive effects in these two grades for Title I students, who tend to be in schools with high concentrations of low achievers.

- In the first two grades, positive effects of CE in math are obtained only in schools with high concentrations of low achievers.

The findings with respect to concentrations of low achievers suggest that schools with more need to provide CE services tend to make greater efforts and produce better results.

The last set of anlyses by schools' demographic characteristics was performed for subets of schools by levels of their per-pupil expenditures in regular and compensatory education. The results are summarized in Table B1-6. Some noteworthy findings include:

- In grades 1 and 3, positive effects of CE in reading are obtained for schools with high per-pupil CE expenditures. In grades 5 and 6, evidence for positive effects of reading CE is observed in schools with high expenditures for both regular and compensatory education.

- In grades 3, 5, and 6, schools with higher CE expenditures, especially those also with higher regular expenditures, show a more positive picture for the effects of CE in math. Elsewhere, no consistent pattern of results is found in math.

Table B1-2

Average Fall-to-Spring VSS Gain for CE Students by Geographic Region and Criteria for Gain

GRADE	Geographic Region	Sample Size	Fall-to-Spring VSS Gain			80% Credibility Interval		Criteria for Gain*			
			Mean	S.D.	S.E.	Lower Limit	Upper Limit	Percentile Maintenance		Deflated Growth	
	Reading										
1	Northeast	1,400	59.23	35.49	.95	58.01	60.44	60	63	61	50
	North Central	718	51.52	31.63	1.18	50.01	53.03	60	63	61	50
	Northwest	369	50.78	35.21	1.83	48.43	53.13	60	63	61	50
	South	1,859	62.52	35.98	.83	61.45	63.58	57	66	56	50
2	Northeast	1,628	44.09	34.20	.85	43.00	45.17	42	42	42	35
	North Central	857	43.73	34.55	1.18	42.22	45.24	43	41	40	35
	Northwest	309	43.44	37.45	2.13	40.72	46.17	43	43	42	35
	South	1,894	41.39	36.84	.85	40.31	42.48	42	43	42	35
3	Northeast	1,510	31.91	31.95	.82	30.86	32.97	36	36	36	26
	North Central	734	35.47	30.43	1.12	34.04	36.91	35	34	34	26
	Northwest	255	41.64	38.32	2.40	38.57	44.71	34	34	34	26
	South	2,036	34.68	34.76	.77	33.69	35.66	32	34	34	26
4	Northeast	1,303	30.52	34.46	.95	29.30	31.74	32	26	32	22
	North Central	663	28.34	34.87	1.35	26.60	30.07	34	26	32	22
	Northwest	224	27.19	40.90	2.73	23.69	30.69	34	26	35	22
	South	1,685	31.53	40.19	.98	30.27	32.78	31	31	31	22
5	Northeast	1,294	23.94	34.99	.97	22.70	25.19	26	26	29	20
	North Central	650	27.78	33.62	1.32	26.10	29.47	27	26	29	20
	Northwest	145	21.64	40.45	3.36	17.31	25.97	23	25	25	20
	South	1,527	25.84	35.93	.92	24.66	27.02	29	26	29	20
6	Northeast	1,066	27.19	34.97	1.07	25.82	28.57	29	25	31	20
	North Central	715	24.34	30.19	1.13	22.89	25.78	30	25	31	20
	Northwest	134	26.13	35.35	3.05	22.20	30.07	29	22	27	20
	South	1,592	24.49	38.44	.96	23.25	25.72	32	25	31	20
	Math										
1	Northeast	695	64.18	36.30	1.38	62.42	65.94	59	61	58	47
	North Central	445	55.93	33.96	1.61	53.87	57.99	55	61	58	47
	Northwest	223	47.03	37.70	2.52	43.80	50.26	57	61	58	47
	South	1,419	61.91	37.43	.99	60.64	63.19	56	62	54	47
2	Northeast	692	56.24	41.74	1.59	54.21	58.27	57	59	54	42
	North Central	573	55.32	38.86	1.62	53.24	57.40	54	59	54	42
	Northwest	154	48.47	39.77	3.20	44.37	52.57	53	57	52	42
	South	1,366	52.32	38.68	1.05	50.98	53.66	53	57	52	42
3	Northeast	739	60.05	42.01	1.55	58.07	62.03	59	62	57	43
	North Central	569	58.20	39.49	1.66	56.08	60.32	58	62	57	43
	Northwest	132	61.47	46.31	4.03	56.27	66.67	58	62	57	43
	South	1,490	46.30	42.67	1.11	44.89	47.72	58	62	57	43
4	Northeast	711	45.94	42.37	1.59	43.91	47.97	50	53	49	46
	North Central	545	51.33	41.30	1.77	49.07	53.60	52	56	54	46
	Northwest	146	57.79	48.55	4.02	52.61	62.97	48	53	49	46
	South	1,250	46.68	45.65	1.29	45.03	48.34	45	55	45	46
5	Northeast	614	42.12	47.04	1.90	39.69	44.55	41	45	40	29
	North Central	564	45.59	43.74	1.84	43.23	47.94	42	45	40	29
	Northwest	132	53.80	43.69	3.80	48.89	58.70	38	45	40	29
	South	1,189	38.26	44.02	1.28	36.63	39.90	41	45	40	29
6	Northeast	595	39.14	45.87	1.88	36.74	41.55	38	42	41	39
	North Central	568	41.52	43.79	1.84	39.17	43.87	41	42	41	39
	Northwest	112	38.32	41.68	3.94	33.24	43.40	43	44	42	39
	South	1,174	41.66	48.58	1.42	39.85	43.48	43	42	41	39

*Percentile Maintenance: VSS gain required to maintain a percentile rank associated with the mean fall VSS for the group.

Deflated Growth: Three-fourths of the VSS gain required to maintain the 50th percentile rank.

Table B1-3

Average Fall-to-Spring VSS Gain for CE Students by School's Urbanism and Criteria for Gain

GRADE	School's Urbanism**	Sample Size	Fall-to-Spring VSS Gain			80% Credibility Interval		Criteria for Gain*			
			Mean	S.D.	S.E.	Lower Limit	Upper Limit	Percentile Maintenance		Deflated Growth	
					Reading						
1	City	2,237	60.70	35.44	.75	59.74	61.66	57	66	56	50
	Suburb	1,114	56.07	37.11	1.11	54.65	57.49	54	66	56	50
	Rural	995	56.30	32.76	1.04	55.57	58.22	60	63	61	50
2	City	2,240	41.27	36.34	.77	40.29	42.26	42	43	42	35
	Suburb	1,418	43.26	34.91	.93	42.08	44.45	41	41	40	35
	Rural	1,030	45.90	34.61	1.08	44.52	47.28	41	41	40	35
3	City	2,325	34.39	33.06	.69	33.51	35.26	32	34	35	26
	Suburb	1,236	33.98	35.15	1.00	32.70	35.26	35	34	35	26
	Rural	974	34.40	32.19	1.03	33.08	35.72	37	38	38	26
4	City	1,827	29.95	38.35	.90	28.80	31.10	30	31	31	22
	Suburb	1,136	31.10	38.54	1.14	29.63	32.56	33	28	35	22
	Rural	912	30.39	34.42	1.14	28.94	31.85	31	26	35	22
5	City	1,744	25.34	35.11	.84	24.27	26.42	28	27	27	20
	Suburb	1,064	22.83	35.47	1.09	21.44	24.22	29	26	29	20
	Rural	808	28.65	35.73	1.26	27.04	30.26	24	25	25	20
6	City	1,633	25.30	37.34	.92	24.11	26.48	28	29	27	20
	Suburb	1,007	26.80	35.09	1.11	25.39	28.22	30	25	31	20
	Rural	867	23.74	33.26	1.13	22.29	25.18	29	22	27	20
					Math						
1	City	1,589	62.04	37.20	.93	60.85	63.24	57	62	54	47
	Suburb	552	59.04	38.82	1.65	56.93	61.16	53	62	54	47
	Rural	641	57.19	34.25	1.35	55.46	58.92	60	63	59	47
2	City	1,591	54.65	41.46	1.04	53.32	55.98	53	57	52	42
	Suburb	521	52.98	40.10	1.76	50.73	55.22	54	59	54	42
	Rural	673	51.99	34.32	1.32	50.30	53.69	56	61	54	42
3	City	1,641	50.58	41.33	1.02	49.28	51.89	59	62	57	43
	Suburb	617	52.23	45.21	1.82	49.90	54.56	58	62	57	43
	Rural	672	58.58	42.57	1.64	56.48	60.69	59	62	57	43
4	City	1,297	49.14	43.98	1.22	47.57	50.70	45	55	45	46
	Suburb	684	42.35	45.38	1.74	40.13	44.57	51	53	49	46
	Rural	671	51.76	42.77	1.65	49.65	53.88	51	56	52	46
5	City	1,317	41.52	45.86	1.26	39.90	43.13	39	49	38	29
	Suburb	571	36.66	43.98	1.84	34.30	39.01	40	49	38	29
	Rural	611	46.74	43.00	1.74	44.51	48.97	44	49	42	29
6	City	1,145	41.96	47.80	1.41	40.15	43.77	44	42	41	39
	Suburb	625	36.62	45.42	1.82	34.30	38.95	41	44	42	39
	Rural	679	42.92	45.20	1.73	40.70	45.14	42	43	45	39

*Percentile Maintenance: VSS gain required to maintain a percentile rank associated with the mean fall VSS for the group.

Deflated Growth: Three-fourths of the VSS gain required to maintain the 50th percentile rank.

**City—city over 50,000; Suburb—suburb of city or city under 50,000; and rural—rural area near or not near a city.

Table B1-4

Average Fall-to-Spring VSS Gain for CE Students by School's Concentrations of Minority Enrollments and Free-Meal Participants and Criteria for Gain

GRADE	Concentrations of Minorities and Free-Meal Participants	Sample Size	Fall-to-Spring VSS Gain			80% Credibility Interval		Criteria for Gain*			
			Mean	S.D.	S.E.	Lower Limit	Upper Limit	Percentile Maintenance			Deflated Growth
					Reading						
1	High/High	2,770	60.47	35.26	.67	59.61	61.33	57	66	56	50
	High/Low	204	56.38	37.35	2.62	53.03	59.72	64	63	61	50
	Low/High	271	50.37	34.53	2.10	47.68	53.05	57	66	56	50
	Low/Low	1,101	56.50	34.97	1.05	55.15	57.85	62	64	61	50
2	High/High	2,692	40.99	35.77	.69	40.11	41.88	43	43	42	35
	High/Low	391	44.83	36.20	1.83	42.49	47.17	41	41	40	35
	Low/High	441	40.53	37.31	1.78	38.25	42.80	41	43	42	35
	Low/Low	1,164	47.53	33.78	.99	46.26	48.80	41	42	42	35
3	High/High	2,873	34.27	32.86	.61	33.49	35.06	33	34	34	26
	High/Low	320	30.05	32.63	1.82	27.72	32.39	41	39	41	26
	Low/High	326	32.64	34.32	1.90	30.21	35.07	31	34	34	26
	Low/Low	1,016	36.15	34.95	1.10	34.75	37.55	43	39	41	26
4	High/High	2,303	30.73	39.68	.83	29.67	31.78	32	31	31	22
	High/Low	247	31.85	37.78	2.40	28.78	34.93	33	31	31	22
	Low/High	307	28.93	35.21	2.01	26.36	31.50	33	28	35	22
	Low/Low	1,018	29.72	32.80	1.03	28.40	31.04	33	26	35	22
5	High/High	2,303	24.96	35.24	.73	24.02	25.90	29	27	27	20
	High/Low	204	25.59	36.04	2.52	22.36	28.82	26	26	29	20
	Low/High	280	28.58	37.89	2.26	25.68	31.47	27	27	27	20
	Low/Low	829	25.25	34.83	1.21	23.70	26.80	26	25	25	20
6	High/High	2,148	25.65	37.39	.81	24.62	26.68	29	29	27	20
	High/Low	244	23.57	32.45	2.08	20.91	26.23	28	25	31	20
	Low/High	234	22.72	36.04	2.36	19.70	25.73	28	29	27	20
	Low/Low	881	25.79	32.22	1.09	24.40	27.18	27	21	27	20
					Math						
1	High/High	2,074	61.84	37.33	.82	60.79	62.89	57	62	54	47
	High/Low	121	60.08	37.36	3.40	55.71	64.46	61	63	59	47
	Low/High	84	59.55	28.88	3.15	55.48	63.61	55	62	54	47
	Low/Low	503	54.30	35.77	1.59	52.26	56.35	65	64	61	47
2	High/High	1,975	53.35	40.63	.91	52.18	54.52	52	57	52	42
	High/Low	222	56.70	36.66	2.46	53.55	59.85	54	61	54	42
	Low/High	198	43.15	36.55	2.60	39.82	46.47	55	61	54	42
	Low/Low	390	59.11	36.20	1.83	56.76	61.46	53	61	54	42
3	High/High	2,189	49.91	41.88	.90	48.76	51.05	57	62	57	43
	High/Low	145	53.52	40.22	3.34	49.21	57.82	59	63	57	43
	Low/High	137	52.58	44.09	3.77	47.72	57.45	59	63	57	43
	Low/Low	459	66.20	43.65	2.04	63.59	68.81	57	62	57	43
4	High/High	1,784	48.16	44.48	1.05	46.81	49.51	44	55	45	46
	High/Low	157	42.22	42.64	3.40	37.86	46.57	51	54	51	46
	Low/High	127	50.96	37.70	3.35	46.65	55.27	45	55	45	46
	Low/Low	584	48.66	44.89	1.86	46.28	51.04	55	58	56	46
5	High/High	1,696	39.96	44.45	1.08	38.58	41.34	40	49	38	29
	High/Low	117	41.58	47.86	4.42	35.88	47.28	39	52	36	29
	Low/High	178	44.36	48.23	3.62	39.73	48.99	40	49	38	29
	Low/Low	508	46.52	44.[illegible]5	1.95	44.02	49.02	43	49	42	29
6	High/High	1,550	40.99	47.51	1.21	39.45	42.54	41	42	41	39
	High/Low	135	45.02	44.12	3.80	40.12	49.92	38	47	39	39
	Low/High	188	39.74	47.87	3.49	35.27	44.21	41	42	41	39
	Low/Low	576	39.91	43.98	1.83	37.57	42.26	47	43	45	39

*Percentile Maintenance: VSS gain required to maintain a percentile rank associated with the mean fall VSS for the group.

Deflated Growth: Three-fourths of the VSS gain required to maintain the 50th percentile rank.

Table B1-5

Average Fall-to-Spring VSS Gain for CE Students by School's Concentration of Low-Achieving Students and Criteria for Gain

GRADE	Concentration of Low-Achievers in Subject Area	Sample Size	Fall-to-spring VSS Gain			80% Credibility Interval		Criteria for Gain*			
			Mean	S.D.	S.E.	Lower Limit	Upper Limit	Percentile Maintenance		Deflated Growth	
			Reading								
1	Low	810	57.07	36.71	1.29	55.42	58.73	67	65	65	50
	Medium	1,044	53.79	33.17	1.03	52.47	55.10	59	65	59	50
	High	2,492	61.19	35.54	.71	60.27	62.10	50	68	53	50
2	Low	934	44.64	35.17	1.15	43.17	46.11	42	44	43	35
	Medium	1,288	45.03	33.38	.93	43.84	46.22	41	41	40	35
	High	2,466	41.11	36.74	.74	40.17	42.06	44	43	41	35
3	Low	802	35.57	35.36	1.25	33.97	37.17	40	39	33	26
	Medium	987	32.68	32.11	1.02	31.37	33.98	36	36	36	26
	High	2,746	34.47	33.34	.64	33.66	35.29	29	32	27	26
4	Low	732	29.59	33.21	1.23	28.01	31.16	32	26	31	22
	Medium	865	29.91	35.98	1.22	28.34	31.48	34	26	32	22
	High	2,278	30.83	39.35	.82	29.78	31.89	31	31	31	22
5	Low	661	26.68	32.84	1.28	25.05	28.32	25	27	25	20
	Medium	848	24.96	38.22	1.31	23.29	26.64	26	26	29	20
	High	2,107	25.07	35.01	.76	24.10	26.05	27	27	27	20
6	Low	741	25.91	28.44	1.04	24.57	27.25	28	21	26	20
	Medium	676	23.67	36.08	1.39	21.90	25.45	27	29	27	20
	High	2,090	25.68	37.87	.83	24.62	26.74	30	29	27	20
			Math								
1	Low	450	60.83	36.63	1.73	58.62	63.04	63	64	61	47
	Medium	664	50.57	32.31	1.25	48.96	52.17	59	61	68	47
	High	1,668	64.08	38.02	.93	62.89	65.27	58	62	57	47
2	Low	461	56.14	38.78	1.81	53.83	58.46	58	58	55	42
	Medium	745	50.26	37.69	1.38	48.49	52.02	54	59	54	42
	High	1,579	54.61	40.61	1.02	53.30	55.91	50	61	49	42
3	Low	517	70.35	41.39	1.82	68.02	72.58	58	63	57	43
	Medium	669	47.97	41.37	1.60	45.92	50.01	59	62	57	43
	High	1,744	49.39	42.07	1.01	48.10	50.68	59	62	57	43
4	Low	548	46.10	44.69	1.91	43.65	48.54	61	58	59	46
	Medium	657	46.31	41.27	1.61	44.25	48.37	49	53	49	46
	High	1,447	49.58	45.21	1.19	48.06	51.10	49	55	45	46
5	Low	475	46.51	42.43	1.95	44.02	49.00	42	49	42	29
	Medium	555	42.15	48.60	2.06	39.51	44.79	41	45	40	29
	High	1,469	39.95	44.07	1.15	38.48	41.42	39	49	38	29
6	Low	571	37.19	43.41	1.82	34.87	39.52	44	43	42	39
	Medium	503	41.74	45.81	2.04	39.13	44.36	37	47	39	39
	High	1,375	42.07	47.99	1.29	40.41	43.72	41	42	41	39

*Percentile Maintenance: VSS gain required to maintain a percentile rank associated with the mean fall VSS for the group.

Deflated Growth: Three-fourths of the VSS gain required to maintain the 50th percentile rank.

Table B1-6

Average Fall-to-Spring VSS Gain for CE Students by Category of Regular and CE Expenditures and Criteria for Gain

GRADE	Expenditures for Regular Education and CE	Sample Size	Fall-to-Spring VSS Gain			80% Credibility Interval		Criteria for Gain*			
			Mean	S.D.	S.E.	Upper Limit	Lower Limit	Percentile Maintenance		Deflated Growth	
					Reading						
1	Low Regular/Low CE	1,688	57.51	36.37	.89	56.38	58.64	57	66	56	50
	Low Regular/High CE	623	60.85	32.66	1.31	59.18	62.53	56	66	56	50
	High Regular/Low CE	1,146	60.25	34.58	1.02	58.94	61.56	59	63	61	50
	High Regular/High CE	889	57.17	36.05	1.21	55.62	58.71	54	66	56	50
2	Low Regular/Low CE	1,632	40.96	36.99	.92	39.79	42.14	43	43	42	35
	Low Regular/High CE	893	40.87	34.76	1.16	39.38	42.36	42	43	42	35
	High Regular/Low CE	1,193	46.49	34.91	1.01	45.20	47.79	39	41	40	35
	High Regular/High CE	970	43.57	34.38	1.10	42.16	44.99	40	41	40	35
3	Low Regular/Low CE	1,747	32.97	35.51	.85	31.88	34.06	35	36	36	26
	Low Regular/High CE	876	35.84	31.05	1.05	34.50	37.18	29	32	27	26
	High Regular/Low CE	1,013	33.21	31.66	.99	31.94	34.49	36	38	38	26
	High Regular/High CE	899	36.49	33.45	1.12	35.06	37.92	35	34	34	26
4	Low Regular/Low CE	1,427	29.19	38.32	1.01	27.89	30.49	35	26	32	22
	Low Regular/High CE	814	29.30	36.53	1.28	27.66	30.94	32	31	31	22
	High Regular/Low CE	954	31.52	36.62	1.19	30.00	33.04	33	26	32	22
	High Regular/High CE	680	32.63	38.11	1.46	30.75	34.50	34	26	32	22
5	Low Regular/Low CE	1,308	24.72	35.26	.98	23.48	25.97	27	26	29	20
	Low Regular/High CE	681	23.10	35.50	1.36	21.36	24.84	27	27	27	20
	High Regular/Low CE	1,066	25.32	35.58	1.09	23.92	26.71	27	25	25	20
	High Regular/High CE	561	29.55	35.02	1.48	27.66	31.45	26	26	29	20
6	Low Regular/Low CE	1,391	23.75	36.89	.99	22.49	25.02	31	25	31	20
	Low Regular/High CE	668	24.46	37.61	1.46	22.59	26.32	25	29	27	20
	High Regular/Low CE	966	24.87	32.75	1.05	23.52	26.22	30	22	27	20
	High Regular/High CE	482	32.11	34.71	1.58	30.08	34.13	28	29	27	20
					Math						
1	Low Regular/Low CE	1,188	59.43	36.44	1.06	58.08	60.78	56	62	54	47
	Low Regular/High CE	311	56.13	34.97	1.98	53.59	58.67	55	62	54	47
	High Regular/Low CE	1,002	63.08	38.83	1.23	61.51	64.65	57	61	58	47
	High Regular/High CE	281	58.98	33.32	1.99	56.44	61.53	57	62	54	47
2	Low Regular/Low CE	1,252	49.00	38.26	1.08	47.61	50.38	57	59	54	42
	Low Regular/High CE	308	53.94	38.80	2.21	51.11	56.76	51	61	49	42
	High Regular/Low CE	931	59.20	40.03	1.31	57.52	60.88	55	59	54	42
	High Regular/High CE	294	56.03	42.27	2.47	52.87	59.19	53	57	52	42
3	Low Regular/Low CE	1,275	45.31	43.23	1.21	43.76	46.86	59	62	57	43
	Low Regular/High CE	426	59.87	44.07	2.14	57.14	62.60	57	63	57	43
	High Regular/Low CE	868	55.76	40.17	1.36	54.01	57.50	57	62	57	43
	High Regular/High CE	361	63.52	39.46	2.08	60.86	66.17	59	63	57	43
4	Low Regular/Low CE	1,188	43.91	45.24	1.31	42.23	45.59	49	54	51	46
	Low Regular/High CE	379	47.59	39.74	2.04	44.98	50.21	46	55	45	46
	High Regular/Low CE	731	50.69	43.97	1.63	48.61	52.77	54	59	53	46
	High Regular/High CE	354	56.97	43.94	2.34	53.98	59.96	49	55	45	46
5	Low Regular/Low CE	1,060	35.53	44.47	1.37	33.78	37.28	41	45	40	29
	Low Regular/High CE	365	44.68	43.90	2.30	41.74	47.63	38	49	38	29
	High Regular/Low CE	764	45.47	43.16	1.56	43.47	47.47	40	45	40	29
	High Regular/High CE	310	49.84	48.78	2.77	46.30	53.39	36	52	36	29
6	Low Regular/Low CE	1,077	38.60	46.95	1.43	36.77	40.43	42	42	41	39
	Low Regular/High CE	322	45.12	49.75	2.77	41.57	48.67	37	47	39	39
	High Regular/Low CE	762	41.61	45.20	1.64	39.51	43.70	42	43	45	39
	High Regular/High CE	288	42.60	44.47	2.62	39.25	45.96	37	47	39	39

*Percentile Maintenance: VSS gain required to maintain a percentile rank associated with the mean fall VSS for the group.

Deflated Growth: Three-fourths of the VSS gain required to maintain the 50th percentile rank.

In light of these results, there is a small encouraging sign that points to some relationship between effects of CE and the level of expenditures. However, this finding should not be overemphasized unless it can be replicated in later years (the reader may recall that a similar finding in the first year of the ESAA study was not replicated in the subsequent study years).

On the whole, most of these subset analyses have not helped us to gain a better understanding of the effects of CE.

Norm-Referenced Criteria Applied to Individual Students

In this section we present the results of some additional norm-referenced analyses that implement the percentile-maintenance criterion on an individual basis. Essentially, this set of analyses examines CE students' achievement gains in terms of the z-scores (standardized normal deviates) associated with their pretest and posttest percentile scores. The assumption underlying these analyses stipulates that without CE intervention, the students will achieve z-score gains of zero because they will maintain constant percentile ranks. Under this expectation, effectiveness of CE is demonstrated by a positive mean gain in z-scores for the CE students. Accordingly, we performed simple t-tests on the mean z-score gains in order to evaluate the effects of CE. Table B1-7 presents these statistical tests by grade for reading and math.

In reading, the tests show significant positive effects of CE in grades 2 and 3, but not in grade 1. The finding in grade 1 contradicts that in the earlier group-level analysis, showing a negative average z-score gain, whereas the previous analysis shows that the average VSS gain for the CE students exceeds the criterion derived on the group basis. On the other hand, the significance of the positive mean z-score gain in grade 3 provides stronger evidence for the effectiveness of CE than does the analysis based on group-level implementation of the same criterion. In math, implementation of the criterion at the individual level produced evidence for positive effects of CE in grades 1, 3, 5, and 6. Again, the results do not agree completely with those obtained with the group-level analysis. An apparent discrepancy between the results of the two analyses is found in grade 3.

Our confidence in the findings of the norm-referenced analyses is slightly lowered in light of the few discrepant results. One possible explanation is that the individual norms do not properly reflect group performance. Another conjecture is that the result is more sensitive to the floor effects of the achievement tests when the criterion is implemented on an individual basis than when it is implemented on the group level. Furthermore, direct application of the standard to individual performance amounts to a comparison with that of students in the general population whose characteristics and achievement level differ considerably from those of the CE students. For this reason, the z-score gains of CE students are further examined in a later section of Chapter 2, where mean z-score gains will be compared among groups of CE students and non-CE students of similar characteristics.

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Table B1-7

Fall Achievement Status and Fall-to-Spring Gain in Terms of Standardized Normal Deviate (z) Scores for All CE Students by Grade

Grade†	Pretest z Score		Fall-to-Spring Gain in z Score		
	Mean	S.D.	Mean	S.D.	t
Reading					
1	-.55	.88	-.02	.82	-1.89
2	-.69	.84	.02	.66	2.19 *
3	-.80	.83	.05	.57	6.21 **
4	-.83	.78	.01	.58	1.34
5	-.84	.77	-.00	.49	- .49
6	-.87	.78	.01	.46	1.90
Math					
1	-.47	.96	.06	.87	3.62 **
2	-.57	.96	.02	.78	1.54
3	-.65	.92	.06	.77	4.08 **
4	-.72	.90	-.01	.66	- .67
5	-.73	.88	.04	.62	3.66 **
6	-.71	.88	.04	.60	2.93 **

†Sample sizes (N) for each grade can be obtained by summing the N's for the three groups of CE students in Table B1-8.

*Significant at the .05 level.

**Significant at the .01 level.

Table B1-8

Fall Achievement Status and Fall-to-Spring Gain in Terms of Standardized Normal Deviate (z) Scores, by Category of CE Students

Grade	CE Category	Reading						Math					
		N	Pretest z Score	Gain in z Score		t*	F**	N	Pretest z Score	Gain in z score		t*	F**
			Mean	Mean	S.D.				Mean	Mean	S.D.		
1	Title I Students	2,785	-0.68	0.01	0.82	0.93	11.92**	1,598	-0.66	0.12	0.86	5.64	12.36**
	Other-CE Students in Title I Schools	987	-0.30	-0.05	0.79	-1.97		855	-0.22	-0.06	0.85	-2.06	
	CE Students in Other-CE Schools	574	-0.34	-0.16	0.85	-4.59		329	-0.25	0.07	0.90	1.42	
2	Title I Students	3,036	-0.81	0.03	0.65	2.43	8.53**	1,686	-0.77	0.04	0.79	2.19	1.60
	Other-CE Students in Title I Schools	948	-0.29	-0.05	0.64	-2.33		808	-0.24	-0.02	0.76	-0.66	
	CE Students in Other-CE Schools	704	-0.66	0.08	0.71	3.07		291	-0.37	0.02	0.80	0.51	
3	Title I Students	3,022	-0.92	0.07	0.56	6.88	4.57**	1,793	-0.82	0.13	0.75	7.60	28.38**
	Other-CE Students in Title I Schools	884	-0.44	0.00	0.60	0.24		768	-0.35	-0.01	0.80	-0.41	
	CE Students in Other-CE Schools	629	-0.68	0.04	0.62	1.63		369	-0.43	-0.17	0.76	-4.25	
4	Title I Students	2,392	-0.95	0.03	0.59	2.14	1.93	1,434	-0.92	0.08	0.63	4.93	35.50**
	Other-CE Students in Title I Schools	864	-0.57	-0.02	0.55	-1.01		845	-0.44	-0.03	0.64	-3.46	
	CE Students in Other-CE Schools	619	-0.70	0.00	0.60	0.20		373	-0.56	-0.21	0.75	-5.32	
5	Title I Students	2,227	-0.97	-0.00	0.49	-0.30	2.30	1,331	-0.91	0.09	0.61	5.63	11.02**
	Other-CE Students in Title I Schools	802	-0.51	-0.03	0.46	-1.81		768	-0.40	-0.04	0.61	-1.69	
	CE Students in Other-CE Schools	587	-0.78	0.03	0.53	1.26		400	-0.76	0.04	0.66	1.30	
6	Title I Students	1,982	-1.01	0.03	0.47	2.76	6.48**	1,134	-0.83	0.09	0.61	4.96	9.05**
	Other-CE Students in Title I Schools	905	-0.56	0.02	0.43	1.67		858	-0.47	-0.01	0.59	-0.50	
	CE Students in Other-CE Schools	620	-0.90	-0.05	0.45	-2.48		457	-0.84	-0.02	0.56	-0.61	

*t-test of non-zero mean gain for each group of CE students. Critical value for significance at .01 level is 2.33.

**Test of differences in z-score gains among the three groups of CE students is significant at .01 level.

Similar individual-level analyses employing the percentile-maintenance criterion were also performed for the three categories of CE students. The results of these analyses are summarized in Table B1-8. In addition to the t-tests on the mean z-score gains for each group, F-tests are obtained for the differences among the groups. Inspection of the F-tests reveals considerable differences among the groups: positive effects are frequently shown for Title I students, but not for other groups of CE students. The group differences in z-score gains are significant in grades 1, 2, 3, and 6 for reading and in all grades but grade 2 for math.

In reading, significant improvement in z-scores during the school year is obtained in grades 2, 3, and 6 for Title I students, and in grade 2 for students in other-CE schools. In math, significant improvement is obtained for Title I students in all grades but grade 2. No other positive effects are evident for either reading or math CE. These findings are generally consistent with those in the previous group-level analyses with a single exception in grade 1, where the positive gain for Title I students is not significant.

The last set of individual-level analyses for the percentile-maintenance criterion was performed for subsets of schools by demographic characteristics. As in the earlier analyses, the findings did not consistently support differential effects of CE by school characteristics. The results are presented in Tables B1-9 through B1-13.

In summary, the findings from the implementation of the percentile-maintenance criterion on an individual basis tend to agree with the earlier findings on a group basis.

Table B1-9

Fall Achievement Status and Average Fall-to-Spring Gain for CE Students in Terms of Standardized Normal Deviate (z) Scores, by School's Geographic Region

Grade	Geographic Region	Reading: Pretest z Score Mean	Reading: Gain in z Score Mean	Reading: Gain in z Score S.D.	Reading: t*	Reading: F**	Math: Pretest z Score Mean	Math: Gain in z Score Mean	Math: Gain in z Score S.D.	Math: t*	Math: F**
1	Northeast	-0.48	-0.02	0.81	-0.95	34.34**	-0.42	0.14	0.84	4.42	17.52**
	North Central	-0.37	-0.22	0.73	-8.22		-0.30	-0.07	0.79	-1.90	
	Northwest	-0.48	-0.22	0.82	-5.08		-0.35	-0.26	0.92	-4.21	
	South	-0.69	0.09	0.83	4.72		-0.58	0.11	0.88	4.77	
2	Northeast	-0.52	0.03	0.64	1.63	0.91	-0.55	0.07	0.84	2.29	2.30
	North Central	-0.73	0.05	0.65	2.15		-0.49	0.05	0.78	1.67	
	Northwest	-0.82	0.03	0.72	0.62		-0.71	-0.04	0.80	-0.63	
	South	-0.78	0.00	0.67	0.28		-0.61	-0.01	0.76	-0.41	
3	Northeast	-0.68	0.01	0.56	0.64	6.44**	-0.63	0.15	0.76	5.24	7.47**
	North Central	-0.79	0.05	0.54	2.62		-0.54	0.10	0.73	3.13	
	Northwest	-0.78	0.15	0.63	3.90		-0.74	0.13	0.86	1.71	
	South	-0.89	0.07	0.59	5.59		-0.69	-0.01	0.78	-0.30	
4	Northeast	-0.75	0.02	0.53	1.13	0.60	-0.63	-0.05	0.62	-2.00	4.81**
	North Central	-0.78	-0.01	0.55	-0.40		-0.58	0.02	0.64	0.84	
	Northwest	-0.61	-0.01	0.65	-0.34		-0.63	0.17	0.74	2.74	
	South	-0.94	0.02	0.62	1.40		-0.83	-0.02	0.68	-1.11	
5	Northeast	-0.82	-0.02	0.48	-1.63	1.93	-0.75	0.05	0.62	1.93	1.70
	North Central	-0.80	0.02	0.48	0.82		-0.60	0.05	0.63	1.71	
	Northwest	-0.62	-0.06	0.55	-1.38		-0.70	0.16	0.63	2.90	
	South	-0.89	0.01	0.50	0.66		-0.78	0.03	0.62	1.75	
6	Northeast	-0.87	0.03	0.44	2.29	0.82	-0.66	0.00	0.58	0.17	0.73
	North Central	-0.81	-0.00	0.40	-0.01		-0.69	0.04	0.58	1.70	
	Northwest	-0.72	0.03	0.44	0.76		-0.90	0.04	0.52	0.85	
	South	-0.91	0.01	0.49	0.75		-0.72	0.05	0.62	2.64	

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[*] t-test of non-zero mean gain for each region. Critical value for significance at .01 level ranges between 2.33 to 2.36, depending on the degrees of freedom. Sample sizes for each group can be found in Table B1-2.

[**] Test of differences in z-score gains among regions is significant at the .01 level.

Table B1-10

Fall Achievement Status and Average Fall-to-Spring Gain for CE Students in Terms of Standardized Normal Deviate (z) Scores, by School's Urbanism

Grade	School's Urbanism	Reading					Math				
		Pretest z Score	Gain in z Score		t*	F**	Prestest z Score	Gain in z score		t*	F**
		Mean	Mean	S.D.			Mean	Mean	S.D.		
1	City	-0.63	0.04	0.82	2.09	12.92**	-0.59	0.12	0.86	5.45	10.92**
	Suburb	-0.55	-0.07	0.84	-2.82		-0.51	0.04	0.89	1.11	
	Rural	-0.37	-0.10	0.76	4.36		-0.16	-0.07	0.84	-2.10	
2	City	-0.79	-0.00	0.66	-0.13	4.84**	-0.69	0.05	0.80	2.58	2.67
	Suburb	-0.59	0.02	0.66	1.02		-0.49	0.00	0.80	-0.10	
	Rural	-0.60	0.08	0.65	3.74		-0.38	-0.03	0.71	-0.92	
3	City	-0.89	0.07	0.57	5.64	1.74	-0.70	0.08	0.77	4.16	1.96
	Suburb	-0.78	0.03	0.60	1.72		-0.62	0.01	0.80	0.22	
	Rural	-0.59	0.05	0.55	2.85		-0.54	0.05	0.75	1.86	
4	City	-0.92	0.00	0.59	0.24	0.44	-0.84	0.01	0.65	0.47	5.61**
	Suburb	-0.87	0.02	0.59	1.28		-0.70	-0.08	0.69	-3.04	
	Rural	-0.57	0.02	0.55	1.01		-0.50	0.03	0.66	1.22	
5	City	-0.93	-0.00	0.48	-0.11	3.62	-0.84	0.06	0.64	3.61	3.05
	Suburb	-0.89	-0.03	0.49	-2.21		-0.78	-0.01	0.59	-0.44	
	Rural	-0.57	0.03	0.51	1.57		-0.44	0.06	0.62	2.41	
6	City	-0.96	0.02	0.47	1.29	3.32	-0.75	0.05	0.61	2.89	2.20
	Suburb	-0.92	0.04	0.45	2.79		-0.82	-0.01	0.58	-0.33	
	Rural	-0.66	-0.02	0.44	-1.01		-0.53	0.05	0.59	2.07	

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[*] t-test of non-zero mean gain for each category of urbanism. Critical value for significance at .01 level is 2.33. Sample sizes for each group can be found in Table B1-3.

[**] Test of differences in z-score gains among schools of different urbanism is significant at the .01 level.

Table B1-11

Fall Achievement Status and Average Fall-to-Spring Gain for CE Students in Terms of Standardized Normal Deviate (z) Scores, by School's Concentrations of Minority Students and Free-Meal Participants

GRADE	School's Concentrations of Minority Students and Free Meal Participants	Reading					Math				
		Pretest z Score	Gain in z Score		t*	F**	Pretest z Score	Gain in z Score		t*	F**
		Mean	Mean	S.D.			Mean	Mean	S.D.		
1	High/High	-0.68	0.04	0.82	2.61	16.39**	-0.59	0.11	0.87	5.91	12.69**
	High/Low	-0.42	-0.08	0.82	-1.48		-0.31	0.04	0.82	0.50	
	Low/High	-0.59	-0.19	0.81	-3.78		-0.49	0.04	0.71	0.51	
	Low/Low	-0.24	-0.13	0.80	-5.50		-0.05	-0.15	0.86	-3.92	
2	High/High	-0.80	-0.01	0.65	-0.48	5.38**	-0.65	0.02	0.80	0.95	7.17**
	High/Low	-0.60	0.06	0.70	1.62		-0.47	0.08	0.74	1.59	
	Low/High	-0.79	-0.00	0.68	-0.15		-0.46	-0.18	0.73	-3.51	
	Low/Low	-0.40	0.08	0.66	4.20		-0.29	0.12	0.75	3.27	
3	High/High	-0.94	0.07	0.56	6.65	4.55**	-0.71	0.07	0.78	4.31	4.98**
	High/Low	-0.42	-0.05	0.55	-1.62		-0.22	-0.18	0.67	-3.30	
	Low/High	-0.84	0.03	0.60	0.78		-0.89	0.06	0.80	0.90	
	Low/Low	-0.49	0.05	0.60	2.47		-0.42	0.07	0.76	1.96	
4	High/High	-0.96	0.01	0.61	0.61	1.03	-0.82	-0.01	0.66	-0.67	1.31
	High/Low	-1.00	0.07	0.60	1.87		-0.84	-0.04	0.63	-0.86	
	Low/High	-0.89	-0.01	0.56	-0.28		-1.00	0.10	0.57	1.95	
	Low/Low	-0.47	0.02	0.52	0.95		-0.30	-0.02	0.68	-0.60	
5	High/High	-0.94	-0.00	0.49	-0.32	0.77	-0.80	0.04	0.61	2.89	0.32
	High/Low	-0.78	-0.00	0.53	-0.02		-0.93	0.03	0.68	0.42	
	Low/High	-0.93	0.03	0.51	1.05		-0.86	0.09	0.66	1.78	
	Low/Low	-0.53	-0.02	0.49	-1.12		-0.39	0.04	0.63	1.57	
6	High/High	-0.99	0.02	0.48	2.01	0.61	-0.76	0.04	0.61	2.73	1.77
	High/Low	-0.83	-0.01	0.43	-0.45		-0.94	0.12	0.54	2.56	
	Low/High	-0.97	-0.01	0.47	-0.30		-0.79	0.04	0.60	0.89	
	Low/Low	-0.58	0.01	0.42	1.01		-0.47	-0.00	0.57	-0.17	

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[*] t-test of non-zero mean gain for each category of concentrations. Critical value for significance at .01 level ranges between 2.33 and 2.36, depending on the degrees of freedom. Sample sizes for each group can be found in Table B1-4.

[**] Test of differences in z-score gains among categories of concentrations is significant at the .01 level.

Table B1-12

Fall Achievement Status and Average Fall-to-Spring Gain for CE Students in Terms of Standardized Normal Deviate (z) Scores, by School's Concentration of Reading/Math Low-Achieving Students

GRADE	School's Concentration of Reading/Math Low-Achieving Students	Reading					Math				
		Pretest z Score	Gain in z Score		t*	F**	Pretest z Score	Gain in z Score		t*	F**
		Mean	Mean	S.D.			Mean	Mean	S.D.		
1	Low	-0.05	-0.15	0.82	-5.02	35.84**	-0.01	-0.00	0.84	-0.10	39.00**
	Medium	-0.52	-0.14	0.78	-5.94		-0.42	-0.17	0.80	-5.50	
	High	-0.73	0.07	0.82	4.04		-0.62	0.17	0.88	7.83	
2	Low	-0.25	0.02	0.68	0.80	2.55	-0.14	0.05	0.81	1.30	5.23**
	Medium	-0.63	0.06	0.64	3.11		-0.50	-0.06	0.75	-2.06	
	High	-0.83	0.00	0.66	0.33		-0.74	0.05	0.79	2.65	
3	Low	-0.26	0.00	0.60	0.19	5.52**	-0.24	0.07	0.73	2.26	2.20
	Medium	-0.70	0.03	0.56	1.81		-0.66	0.00	0.77	0.11	
	High	-0.99	0.07	0.57	6.86		-0.77	0.07	0.78	3.99	
4	Low	-0.30	0.02	0.53	1.24	0.18	-0.22	-0.06	0.68	-2.01	2.72
	Medium	-0.82	0.01	0.56	0.52		-0.69	-0.02	0.63	-0.89	
	High	-1.00	0.01	0.60	0.76		-0.91	0.02	0.67	0.93	
5	Low	-0.38	-0.01	0.46	-0.39	0.13	-0.29	0.03	0.60	1.15	0.48
	Medium	-0.83	-0.01	0.54	-0.55		-0.76	0.03	0.68	1.05	
	High	-0.98	-0.00	0.48	-0.06		-0.86	0.06	0.61	3.52	
6	Low	-0.43	0.02	0.39	1.08	0.96	-0.41	-0.04	0.57	-1.68	6.08**
	Medium	-0.94	-0.01	0.46	-0.38		-0.91	0.07	0.57	2.79	
	High	-1.01	0.02	0.48	2.04		-0.76	0.05	0.62	3.21	

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* t-test of non-zero mean gain for each category of concentration. Critical value for significance at .01 level is 2.33. Sample sizes for each group can be found in Table B1-5.

** Test of differences in z-score gains among different concentrations of low-achieving students is significant at the .01 level.

Table B1-13

Fall Achievement Status and Average Fall-to-Spring Gain for CE Students in Terms of Standardized Normal Deviate (z) Scores, by Category of Expenditures for Regular and Compensatory Education

GRADE	Category of Expenditures For Regular and Compensatory Education	Reading					Math				
		Pretest z Score	Gain in z Score		t*	F**	Pretest z Score	Gain in z Score		t*	F**
		Mean	Mean	S.D.			Mean	Mean	S.D.		
1	Low Reg/Low CE	-0.65	-0.02	0.83	-0.99	2.42	-0.59	0.07	0.85	2.70	0.83
	Low Reg/High CE	-0.70	0.05	0.76	1.62		-0.62	-0.01	0.82	-0.23	
	High Reg/Low CE	-0.34	-0.04	0.80	-1.67		-0.27	0.08	0.92	2.59	
	High Reg/High CE	-0.54	-0.06	0.83	-2.15		-0.58	0.05	0.78	1.06	
2	Low Reg/Low CE	-0.74	-0.01	0.68	-0.41	3.24	-0.53	-0.08	0.75	-3.64	13.05**
	Low Reg/High CE	-0.79	0.00	0.63	0.04		-0.79	0.07	0.77	1.49	
	High Reg/Low CE	-0.54	0.07	0.67	3.47		-0.53	0.12	0.80	4.68	
	High Reg/High CE	-0.68	0.03	0.65	1.47		-0.70	0.09	0.82	1.84	
3	Low Reg/Low CE	-0.75	0.03	0.60	2.18	3.35	-0.61	-0.07	0.78	-3.13	25.57**
	Low Reg/High CE	-1.09	0.07	0.53	3.94		-0.84	0.20	0.83	4.99	
	High Reg/Low CE	-0.60	0.03	0.54	2.02		-0.52	0.09	0.72	3.66	
	High Reg/High CE	-0.82	0.10	0.59	5.00		-0.87	0.26	0.74	6.72	
4	Low Reg/Low CE	-0.81	-0.01	0.59	-0.61	2.89	-0.76	-0.06	0.68	-3.11	8.95**
	Low Reg/High CE	-1.08	-0.01	0.57	-0.50		-0.89	-0.01	0.59	-0.28	
	High Reg/Low CE	-0.65	0.03	0.57	1.67		-0.44	0.00	0.66	0.08	
	High Reg/High CE	-0.81	0.06	0.59	2.61		-0.95	0.14	0.67	4.05	
5	Low Reg/Low CE	-0.80	-0.01	0.49	-0.85	2.93	-0.76	-0.01	0.62	-0.26	6.22**
	Low Reg/High CE	-1.10	-0.02	0.49	-1.30		-0.81	0.09	0.59	2.88	
	High Reg/Low CE	-0.71	-0.01	0.49	-0.73		-0.54	0.05	0.61	2.27	
	High Reg/High CE	-0.85	0.05	0.50	2.42		-0.97	0.16	0.66	4.14	
6	Low Reg/Low CE	-0.82	-0.00	0.48	-0.21	7.99*	-0.72	0.00	0.60	0.25	3.24
	Low Reg/High CE	-1.16	0.01	0.47	0.72		-0.89	0.11	0.63	3.06	
	High Reg/Low CE	-0.70	-0.01	0.43	-0.40		-0.52	0.03	0.59	1.36	
	High Reg/High CE	-0.98	0.11	0.44	5.41		-0.97	0.09	0.57	2.57	

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[*] t-test of non-zero mean gain for each category of expenditures. Critical value for significance at .01 level is 2.33. Sample sizes for each group can be found in Table B1-6.

[**] Test of differences in z-score gains among expenditure categories is significant at the .01 level.

APPENDIX B 2

SUPPLEMENTARY TABLES FOR ANALYSES OF VARIANCE

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Table B2-1

Two-Way ANOVA of Fall-to-Spring Reading VSS Gain by CE Status and Initial Achievement Status

GRADE	Initial Achievement Status (A)		CE Status (B)						TOTAL
			Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Non-CE Students in Title I Schools	Non-CE Students in Other-CE Schools	Students in Non-CE Schools	
			Reading Gain Score Means						
1	Bottom One-Third	N	917	240	159	1,080	376	461	3,233
		Mean	60.72	59.80	56.05	69.34	69.10	70.04	65.61
	Top Two-Thirds	N	1,868	747	415	6,060	2,862	1,690	13,642
		Mean	58.49	59.53	53.46	67.34	65.19	64.88	64.52
	TOTAL	N	2,785	987	574	7,140	3,238	2,151	16,875
		Mean	59.23	59.59	54.18	67.64	65.64	65.99	64.73
2	Bottom One-Third	N	1,770	346	348	1,227	322	570	4,583
		Mean	45.20	43.05	51.04	43.19	51.41	44.07	45.24
	Top Two-Thirds	N	1,266	602	356	4,800	2,520	1,384	10,928
		Mean	39.15	40.31	40.99	43.22	42.39	41.37	42.09
	TOTAL	N	3,036	948	704	6,027	2,842	1,954	15,511
		Mean	42.68	41.31	45.96	43.22	43.41	42.16	43.02
3	Bottom One-Third	N	1,983	385	330	1,117	370	546	4,731
		Mean	37.29	35.30	38.24	36.02	40.35	37.21	37.13
	Top Two-Thirds	N	1,039	499	299	4,860	2,557	1,392	10,646
		Mean	31.51	26.90	30.49	31.38	34.59	31.65	31.97
	TOTAL	N	3,022	884	629	5,977	2,927	1,938	15,377
		Mean	35.31	30.56	34.55	32.25	35.32	33.22	33.55
4	Bottom One-Third	N	1,590	412	333	1,334	466	570	4,705
		Mean	34.62	29.77	32.25	35.38	36.59	36.14	34.62
	Top Two-Thirds	N	802	452	286	5,118	2,706	1,385	10,749
		Mean	24.89	27.28	26.01	27.92	27.40	28.35	27.54
	TOTAL	N	2,392	864	619	6,452	3,172	1,955	15,454
		Mean	31.35	28.46	29.36	29.46	28.75	30.62	29.70
5	Bottom One-Third	N	1,717	402	369	1,658	663	725	5,534
		Mean	26.12	22.67	29.44	26.34	32.16	31.70	27.61
	Top Two-Thirds	N	510	400	218	5,152	2,940	1,480	10,700
		Mean	22.08	25.13	25.25	26.74	28.79	25.94	26.88
	TOTAL	N	2,227	802	587	6,810	3,603	2,205	16,234
		Mean	25.19	23.89	27.88	26.64	29.41	27.84	27.13
6	Bottom One-Third	N	1,450	480	412	1,553	1,107	812	5,814
		Mean	28.04	27.88	22.87	28.09	26.36	27.18	27.23
	Top Two Thirds	N	532	425	208	5,338	4,698	1,703	12,904
		Mean	20.48	25.68	17.34	25.28	23.39	24.23	24.14
	TOTAL	N	1,982	905	620	6,891	5,805	2,515	18,718
		Mean	26.01	26.85	21.01	25.91	23.95	25.18	25.10

Table B2-2

Two-Way ANOVA of Fall-to-Spring Math VSS Gain by CE Status and Initial Achievement Status

GRADE	Initial Achievement Status (A)		CE Status (B)						
			Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Non-CE Students in Title I Schools	Non-CE Students in Other-CE Schools	Students in Non-CE Schools	TOTAL
			Math Gain Score Means						
1	Bottom One-Third	N	669	211	104	1,669	494	512	3,659
		Mean	64.65	63.14	62.78	64.81	65.84	60.08	64.11
	Top Two-Thirds	N	929	644	225	6,771	2,990	1,620	13,179
		Mean	59.35	55.25	62.32	62.77	59.48	57.91	60.81
	TOTAL	N	1,598	855	329	8,440	3,484	2,132	16,838
		Mean	61.57	57.20	62.46	63.17	60.38	58.43	61.52
2	Bottom One-Third	N	934	266	114	1,881	530	536	4,261
		Mean	55.28	58.48	53.84	60.05	61.23	53.97	58.12
	Top Two-Thirds	N	752	542	177	5,618	2,717	1,411	11,217
		Mean	51.18	51.76	54.69	54.37	56.23	52.28	54.22
	TOTAL	N	1,686	808	291	7,499	3,247	1,947	15,478
		Mean	53.45	53.97	54.36	55.79	57.05	52.75	55.30
3	Bottom One-Third	N	1,119	300	153	1,934	600	578	4,684
		Mean	59.27	55.39	42.86	60.25	63.01	58.05	59.22
	Top Two-Thirds	N	674	468	216	5,367	2,589	1,364	10,678
		Mean	48.86	46.22	48.76	56.15	60.62	57.41	56.35
	TOTAL	N	1,793	768	369	7,301	3,189	1,942	15,362
		Mean	55.36	49.80	46.32	57.24	61.07	57.60	57.23
4	Bottom One-Third	N	885	329	166	1,801	681	530	4,392
		Mean	56.31	45.50	40.25	55.84	54.17	54.31	54.13
	Top Two-Thirds	N	549	516	207	5,594	2,734	1,424	11,024
		Mean	48.65	45.11	28.78	48.66	50.60	48.72	48.61
	TOTAL	N	1,434	845	373	7,395	3,415	1,954	15,416
		Mean	53.38	45.26	33.88	50.41	51.31	50.23	50.16
5	Bottom One-Third	N	883	301	229	2,008	779	643	4,843
		Mean	47.12	40.62	46.69	42.70	45.87	51.05	45.18
	Top Two-Thirds	N	448	467	171	5,721	3,008	1,560	11,375
		Mean	37.38	35.78	36.14	42.95	47.82	44.43	43.83
	TOTAL	N	1,331	768	400	7,729	3,787	2,203	16,218
		Mean	43.84	37.68	42.18	42.89	47.42	46.36	44.23
6	Bottom One-Third	N	650	368	262	1,960	1,229	658	5,127
		Mean	48.72	43.84	39.63	44.56	42.94	40.51	43.88
	Top Two-Thirds	N	484	490	195	5,814	4,731	1,837	13,551
		Mean	37.71	35.63	31.54	38.94	38.23	38.69	38.39
	TOTAL	N	1,134	858	457	7,774	5,960	2,495	18,678
		Mean	44.02	39.18	36.18	40.36	39.20	39.17	39.90

Table B2-3

One-Way ANOVA of Fall-to-Spring Standardized Reading/Math VSS Gain by CE Status

CE Status		Grade					
		1	2	3	4	5	6
		Reading					
Title I Students in Title I Schools	N	2,785	3,036	3,022	2,392	2,227	1,982
	Mean	.05	.03	.05	.04	.01	.04
Other-CE Students in Title I Schools	N	987	948	884	864	802	905
	Mean	-.05	-.02	-.05	-.01	-.03	.04
CE Students in Other-CE Schools	N	574	704	629	619	587	620
	Mean	-.16	.09	.03	.00	.04	-.03
Non-CE Students in Title I Schools	N	7,140	6,027	5,977	6,452	6,810	6,891
	Mean	.03	-.01	-.03	-.01	-.02	.00
Non-CE Students in Other-CE Schools	N	3,238	2,842	2,927	3,172	3,603	5,805
	Mean	-.09	-.03	.01	-.03	.01	-.03
Students in Non-CE Schools	N	2,151	1,954	1,938	1,955	2,205	2,515
	Mean	.04	-.02	-.01	.01	.00	.00
TOTAL	N	16,875	15,511	15,377	15,454	16,234	18,718
	Mean	-.00	-.00	-.00	-.00	-.01	-.00
F STATISTIC		18.20*	5.66*	11.34*	5.19*	4.74*	9.87*
		Math					
Title I Students in Title I Schools	N	1,598	1,686	1,793	1,434	1,331	1,134
	Mean	.13	.04	.06	.10	.07	.13
Other-CE Students in Title I Schools	N	855	808	768	845	768	858
	Mean	-.06	-.01	-.10	-.05	-.07	.03
CE Students in Other-CE Schools	N	329	291	369	373	400	457
	Mean	.06	.01	-.14	-.22	.03	.03
Non-CE Students in Title I Schools	N	8,440	7,449	7,301	7,395	7,729	7,774
	Mean	.04	.00	-.01	-.01	-.04	-.00
Non-CE Students in Other-CE Schools	N	3,484	3,247	3,189	3,415	3,787	5,960
	Mean	-.08	-.01	.02	-.01	.01	-.03
Students in Non-CE Schools	N	2,132	1,947	1,942	1,954	2,203	2,495
	Mean	-.06	-.04	.00	-.01	.02	-.02
TOTAL	N	16,838	15,478	15,362	15,416	16,218	18,678
	Mean	.00	-.0[illegible]	-.00	-.01	-.01	-.00
F STATISTIC		21.76*	2.55	8.73*	17.06*	9.75*	13.99*

*Means in standardized VSS gain scores differ significantly among the six analysis groups at .01 level.

Table B2-4

One-Way ANOVA of Fall-to-Spring Reading/Math Gain in Terms of Standardized Normal Deviate (z) Scores for the Three Groups of CE Students and Two Comparison Groups of Needy Non-CE Students

CE Status		Grade					
		1	2	3	4	5	6
		Reading					
Title I Students in Title I Schools	N	2,785	3,036	3,022	2,392	2,227	1,982
	Mean	.01	.03	.07	.03	-.00	.03
Other-CE Students in Title I Schools	N	987	948	884	864	802	905
	Mean	-.05	-.05	.00	-.02	-.03	.02
CE Students in Other-CE Schools	N	574	704	629	619	587	620
	Mean	-.16	.08	.04	.00	.03	-.05
Needy Non-CE Students in CE Schools	N	1,999	1,572	1,473	1,729	1,899	2,124
	Mean	-.07	-.03	.04	.01	-.01	-.01
Needy Non-CE Students in Non-CE Schools	N	541	678	591	613	548	676
	Mean	-.11	-.05	-.03	.01	-.02	.01
Total	N	6,886	6,938	6,599	6,217	6,063	6,307
	Mean	-.04	.00	.04	.01	-.01	.01
F Statistic		8.02*	6.89*	4.87*	1.00	1.27	3.86*
		Math					
Title I Students in Title I Schools	N	1,598	1,686	1,793	1,434	1,331	1,134
	Mean	.12	.04	.13	.08	.09	.09
Other-CE Students in Title I Schools	N	855	808	768	845	768	858
	Mean	-.06	-.02	-.01	-.08	-.04	-.01
CE Students in Other-CE Schools	N	329	291	369	373	400	457
	Mean	.07	.02	-.17	-.21	.04	-.02
Needy Non-CE Students in CE Schools	N	1,599	1,353	1,370	1,455	1,606	1,767
	Mean	-.01	-.00	-.02	-.00	.02	-.03
Needy Non-CE Students in Non-CE Schools	N	1,051	1,035	1,057	1,169	1,270	1,321
	Mean	-.15	-.06	-.04	-.00	-.01	-.04
Total	N	5,432	5,173	5,357	5,276	5,375	5,537
	Mean	-.00	-.00	.02	-.01	.03	-.00
F Statistic		17.65*	2.85	19.12*	17.68*	7.21*	8.84*

* Means in z-score gain differ significantly among the five analysis groups at .01 level.

Table B2-5

One-Way ANOVA of Fall-to-Spring Standardized Reading/Math VSS Gain for the Three Groups of CE Students and Two Comparison Groups of Needy Non-CE Students

CE Status		Grade 1	2	3	4	5	6
				Reading			
Title I Students in Title I Schools	N	2,785	3,036	3,022	2,392	2,227	1,982
	Mean	.05	.03	.05	.04	.01	.04
Other-CE Students in Title I Schools	N	987	948	884	864	802	905
	Mean	-.05	-.02	-.05	-.01	-.03	.04
CE Students in Other-CE Schools	N	574	704	629	619	587	620
	Mean	-.16	.09	.03	.00	.04	-.03
Needy Non-CE Students in CE Schools	N	1,999	1,572	1,473	1,729	1,899	2.124
	Mean	-.04	-.02	.03	.02	-.01	.00
Needy Non-CE Students in Non-CE Schools	N	541	678	591	613	548	676
	Mean	-.07	-.04	-.05	.02	-.03	.03
Total	N	6,886	6,938	6,599	6,217	6,063	6,307
	Mean	-.02	.01	.02	.02	-.00	.02
F Statistic		9.78*	5.49*	6.92*	1.52	2.23	3.52*
				Math			
Title I Students in Title I Schools	N	1,598	1,686	1,793	1,434	1,331	1,134
	Mean	.13	.04	.06	.10	.07	.13
Other-CE Students in Title I Schools	N	855	808	768	845	768	858
	Mean	-.06	-.01	-.10	-.05	-.07	.03
CE Students in Other-CE Schools	N	329	291	369	373	400	457
	Mean	.06	.01	-.14	-.22	.03	.03
Needy Non-CE Students in CE Schools	N	1,599	1,353	1,370	1,455	1,606	1,767
	Mean	-.00	-.01	-.05	.02	-.01	.01
Needy Non-CE Students in Non-CE Schools	N	1,051	1,035	1,057	1,169	1,270	1,321
	Mean	-.13	-.08	-.02	.00	-.04	-.00
Total	N	5,432	5,173	5,357	5,276	5,375	5,537
	Mean	.01	-.01	-.02	.01	-.00	.04
F Statistic		16.15*	3.85*	9.71*	19.28*	7.68*	8.09*

*Means in standardized VSS gain scores differ significantly among the five analysis groups at .01 level.

Table B2-6

Average Fall-to-Spring VSS Gain in Reading by CE Status and Teacher's Judgment of Need in CE (Sample Sizes Are Given in Parentheses)†

Grade	Teacher's Judgment of CE Need (NEED)	CE Status (CE)					
		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Non-CE Students in CE Schools	Non-CE Students in Non-CE Schools	Total
1	Need	58.03 (2,188)	51.42 (479)	49.27 (361)	54.83 (1,999)	52.79 (541)	55.24 (5,568)
	Don't Need	63.93 (579)	67.02 (504)	62.49 (213)	69.97 (8,339)	70.44 (1,629)	69.46 (11,264)
	Total	59.26 (2,767)	59.42 (983)	54.18 (574)	67.05 (10,338)	66.04 (2,170)	64.75 (16,832)
	Test Statistics:	Effect* F	NEED 636.82**	CE|NEED 7.82**	CE x NEED|CE, NEED 8.08**	CE|NEED, CE x NEED 5.87**	
2	Need	42.78 (2,462)	40.43 (540)	45.57 (533)	39.79 (1,572)	38.41 (678)	41.49 (5,785)
	Don't Need	42.41 (525)	42.31 (402)	47.79 (169)	44.06 (7,257)	44.53 (1,259)	44.02 (9,612)
	Total	42.71 (2,987)	41.24 (942)	46.10 (702)	43.30 (8,829)	42.39 (1,937)	43.07 (15,397)
	Test Statistics:	Effect* F	NEED 21.38**	CE|NEED 4.32**	CE x NEED|CE, NEED 2.56	CE|NEED, CE x NEED 2.89	
3	Need	36.01 (2,525)	33.76 (439)	34.80 (448)	34.10 (1,473)	29.48 (591)	34.51 (5,476)
	Don't Need	32.37 (482)	30.26 (420)	34.24 (176)	33.01 (7,374)	35.38 (1,357)	33.21 (9,809)
	Total	35.43 (3,007)	32.05 (85[illegible])	34.64 (624)	33.19 (8,847)	33.59 (1,948)	33.68 (15,285)
	Test Statistics	Effect* F	NEED 5.98	CE|NEED 2.21	CE x NEED|CE, NEED 5.84**	CE|NEED, CE x NEED 1.25	
4	Need	31.36 (2,017)	26.06 (432)	30.54 (459)	30.10 (1,729)	30.25 (613)	30.31 (5,250)
	Don't Need	30.70 (329)	32.40 (407)	25.50 (159)	28.98 (7,839)	29.99 (1,335)	29.25 (10,069)
	Total	31.27 (2,346)	29.14 (839)	29.24 (618)	29.18 (9,568)	30.07 (1,948)	29.62 (15,319)
	Test Statistics	Effect* F	NEED 3.50	CE|NEED 1.28	CE x NEED|CE, NEED 2.93	CE|NEED, CE x NEED .91	
5	Need	25.52 (1,834)	25.72 (485)	27.44 (462)	24.74 (1,899)	22.60 (548)	24.84 (5,228)
	Don't Need	24.33 (339)	22.72 (301)	29.31 (124)	28.24 (8,453)	29.57 (1,675)	28.26 (10,892)
	Total	25.34 (2,173)	23.87 (786)	27.83 (586)	27.59 (10,352)	27.85 (2,223)	27.15 (16,120)
	Test Statistics	Effect* F	NEED 41.17**	CE|NEED 1.88	CE x NEED|CE, NEED 2.88	CE|NEED, CE x NEED 1.77	
6	Need	26.83 (1,671)	27.73 (526)	21.52 (471)	23.89 (2,124)	25.14 (676)	25.11 (5,468)
	Don't Need	24.38 (272)	25.34 (373)	19.64 (148)	25.24 (10,502)	25.28 (1,871)	25.17 (13,166)
	Total	26.48 (1,943)	26.74 (899)	21.07 (619)	25.01 (12,626)	25.24 (2,547)	25.15 (18,634)
	Test Statistics	Effect* F	NEED .01	CE|NEED 4.05**	CE x NEED|CE, NEED 1.41	CE|NEED, CE x NEED 2.90	

†Teacher's judgment of need in reading CE was made in October-November, 1976. Students with missing data for CE status, teacher's judgment of need for CE or test scores were excluded in the analysis.

*NEED = unadjusted differences between students who were judged to be in need of CE and those who were not so judged; CE|NEED = differences among students of different CE statuses after adjusting for differences with respect to judged need in CE; CE x NEED|CE, NEED = interaction effects betwen CE status and judged need in CE; CE|NEED, CE x NEED = CE effects adjusted for both main effects of NEED and the interaction effects between CE and NEED.

**F-test is significant at the .01 level.

Table B2-7

Average Fall-to-Spring VSS Gain in Math by CE Status and Teacher's Judgment of Need in CE (Sample Sizes Are Given in Parentheses)†

Grade	Teacher's Judgment of CE Need (NEED)	CE Status (CE)					Total
		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Non-CE Students in CE Schools	Non-CE Students in Non-CE Schools	
1	Need	59.70 (1,163)	57.65 (336)	56.89 (181)	54.13 (1,599)	49.13 (1,051)	54.80 (4,330)
	Don't Need	66.93 (421)	56.61 (516)	69.28 (148)	64.62 (7,335)	62.93 (4,044)	63.87 (12,464)
	Total	61.62 (1,584)	57.02 (852)	62.46 (329)	62.74 (8,934)	60.09 (5,095)	61.53 (16,794)
	Test Statistics:	Effect*	NEED	CE|NEED	CE x NEED|CE, NEED	CE|NEED, CE x NEED	
		F	222.62**	14.58**	8.37**	12.77**	
2	Need	51.11 (1,187)	51.28 (366)	47.20 (156)	50.47 (1,353)	46.74 (1,035)	49.66 (4,097)
	Don't Need	59.19 (454)	56.20 (438)	62.50 (134)	58.62 (6,594)	54.94 (3,646)	57.40 (11,266)
	Total	53.35 (1,641)	53.96 (804)	54.27 (290)	57.23 (7,947)	53.13 (4,681)	55.34 (15,363)
	Test Statistics:	Effect*	NEED	CE|NEED	CE x NEED|CE, NEED	CE|NEED, CE x NEED	
		F	130.00**	8.27**	1.04	5.73**	
3	Need	55.04 (1,380)	43.94 (332)	40.14 (199)	49.07 (1,370)	50.11 (1,057)	50.42 (4,338)
	Don't Need	56.89 (399)	56.27 (412)	54.21 (166)	58.85 (6,403)	63.49 (3,551)	60.12 (10,931)
	Total	55.46 (1,779)	50.77 (744)	46.54 (365)	57.13 (7,773)	60.42 (4,608)	57.36 (15,269)
	Test Statistics:	Effect*	NEED	CE|NEED	CE x NEED|CE, NEED	CE|NEED, CE x NEED	
		F	177.32**	15.40**	4.88**	8.30**	
4	Need	53.47 (1,126)	45.37 (386)	45.04 (251)	48.22 (1,455)	46.97 (1,169)	48.80 (4,387)
	Don't Need	53.80 (283)	47.15 (423)	10.79 (121)	50.87 (6,478)	51.96 (3,599)	50.71 (10,904)
	Total	53.54 (1,409)	46.30 (809)	33.90 (372)	50.38 (7,933)	50.74 (4,768)	50.17 (15,291)
	Test Statistics:	Effect*	NEED	CE|NEED	CE x NEED|CE, NEED	CE|NEED, CE x NEED	
		F	6.67**	18.59**	16.97**	25.21**	
5	Need	44.82 (1,002)	35.72 (414)	42.06 (281)	38.86 (1,606)	35.75 (1,270)	39.22 (4,573)
	Don't Need	40.28 (283)	41.44 (333)	41.72 (118)	47.05 (6,680)	45.89 (4,114)	46.25 (11,528)
	Total	43.82 (1,285)	38.27 (747)	41.96 (399)	45.46 (8,286)	43.50 (5,384)	44.25 (16,101)
	Test Statistics:	Effect*	NEED	CE|NEED	CE x NEED|CE, NEED	CE|NEED, CE x NEED	
		F	82.22**	4.34**	5.71**	2.38	
6	Need	44.12 (883)	36.77 (391)	36.11 (315)	35.43 (1,767)	33.73 (1,321)	36.75 (4,677)
	Don't Need	44.88 (226)	42.37 (448)	37.52 (141)	39.52 (8,613)	43.70 (4,489)	41.03 (13,917)
	Total	44.27 (1,109)	39.76 (839)	36.55 (456)	38.83 (10,380)	41.44 (5,810)	39.95 (18,594)
	Test Statistics:	Effect*	NEED	CE|NEED	CE x NEED|CE, NEED	CE|NEED, CE x NEED	
		F	30.53**	10.99**	3.39**	4.08**	

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†Teacher's judgment of need in math CE was made in October-November, 1976. Students with missing data for CE status, teacher's judgment of need for CE, or test scores were excluded in the analysis.

*NEED = unadjusted differences between students who were judged to be in need of CE and those who were not so judged; CE|NEED = differences among students of different CE statuses after adjusting for differences with respect to judged need in CE; CE x NEED|CE, NEED = interaction effects between CE status and judged need in CE; CE|NEED, CE x NEED = CE effects adjusted for both main effects of NEED and the interaction effects between CE and NEED.

**F-test is significant at the .01 level.

Table B2-8

One-Way ANOVA of Fall-to-Spring Standardized Gain Scores in Practical Achievement for the Three Groups of Reading/Math CE Students and Two Comparison Groups of Needy Non-CE Students*

CE Status		Reading CE Status			Math CE Status		
		Grade 4	Grade 5	Grade 6	Grade 4	Grade 5	Grade 6
Title I Students in Title I Schools	N	2,367	2,218	1,979	1,426	1,321	1,138
	Mean	-.02	-.01	.05	-.03	-.01	.03
Other-CE Students in Title I Schools	N	858	798	894	844	757	839
	Mean	.03	.04	.06	.00	.01	.05
CE Students in Other-CE Schools	N	609	576	613	366	392	450
	Mean	-.07	-.04	.08	-.11	-.02	.12
Needy Non-CE Students in CE Schools	N	1,730	1,874	2,115	1,469	1,597	1,760
	Mean	.02	.02	.07	-.01	.02	.09
Needy Non-CE Students in Non-CE Schools	N	577	521	637	1,138	1,237	1,290
	Mean	.02	-.02	.08	-.03	-.05	.01
Total	N	6,151	5,987	6,238	5,243	5,304	5,477
	Mean	-.00	.00	.06	-.02	-.01	.06
F Statistic		2.72	1.48	.38	1.86	1.54	2.73

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* Mean standardized gain scores in practical achievement do not differ significantly among the five analysis groups at .01 level.

Table B2-9

One-Way ANOVA of Fall-to-Spring Standardized Change Scores in Student Affect for the Three Groups of Reading/Math CE Students and Two Comparison Groups of Needy Non-CE Students

CE Status		Grade				
		2	3	4	5	6
Reading CE Status						
Title I Students in Title I Schools	N	2,748	2,784	2,206	2,097	1,867
	Mean	.02	-.00	-.00	.02	.08
Other-CE Students in Title I Schools	N	869	826	828	753	847
	Mean	.15	-.02	-.04	-.03	.03
CE Students in Other-CE Schools	N	651	593	586	555	584
	Mean	-.02	.00	-.00	.11	.06
Needy Non-CE Students in CE Schools	N	1,423	1,369	1,644	1,785	2,022
	Mean	-.03	.03	.02	.02	.04
Needy Non-CE Students in Non-CE Schools	N	578	547	566	501	628
	Mean	.07	-.06	.07	-.04	.00
Total	N	6,269	6,119	5,830	5,691	5,948
	Mean	.03	-.00	.01	.02	.05
F Statistic		4.13*	.77	1.04	2.38	1.07
Math CE Status						
Title I Students in Title I Schools	N	1,500	1,651	1,324	1,268	1,057
	Mean	.00	.01	-.02	.02	.16
Other-CE Students in Title I Schools	N	725	679	799	704	807
	Mean	.05	.04	-.04	.06	-.01
CE Students in Other-CE Schools	N	279	353	353	375	432
	Mean	.13	-.04	.01	.06	.15
Needy Non-CE Students in CE Schools	N	1,233	1,289	1,370	1,481	1,677
	Mean	.03	-.01	.04	.01	.04
Needy Non-CE Students in Non-CE Schools	N	897	993	1,095	1,201	1,249
	Mean	.06	.03	.03	-.00	.03
Total	N	4,634	4,965	4,941	5,029	5,222
	Mean	.04	.01	.01	.02	.06
F Statistic		1.07	.57	1.22	.65	6.03*

* Mean standardized change scores in student affect differ significantly among the five analysis groups at .01 level.

APPENDIX B3

SUPPLEMENTARY TEXT AND TABLES FOR ANALYSES OF COVARIANCE

Analysis for Reading and Math Achievement

In the past decade, attention has concentrated on improving the ANCOVA technique through corrections for unreliabilities when fallible measures are employed as covariates. Porter (1967) proposed a method for such corrections that is simple and easy to implement. Essentially, he suggested the use of estimated true scores based on within-group regression as the covariate. More elaborated corrections originated from Lord's (1960) idea of large-sample covariance analysis have been devised by DeGracie and Fuller (1972). Rindskopf (1976) applied both Porter's correction and the method of DeGracie and Fuller to analyze the same data and found no substantial disagreement in the results. For practicality, we adopted Porter's method for the corrections in the present analyses. Even with the corrections for unreliabilities, large preexisting differences may still not be adequately adjusted unless a complete discriminate variate can be found to serve as the covariate (Cronbach et al., 1976). Attempts to obtain more comparable groups for this type of analysis can often help reduce the regression effects that present major problems in these analyses. With these considerations, we explored four different sets of analyses using different groups:

The Six CE Groups. The substantial preexisting differences among the groups are likely to be under-adjusted with the technique. But we proceed with the analysis so that the appropriateness of the corrections for unreliabilities of the covariates can be examined. Because of the large sample that entails exhorbitant computer costs for the analysis, we reduced the amount of data by selecting a 30 percent random sample of the non-CE students to supply the data for the three non-CE groups, but kept the three groups of CE students intact so that they would be well represented.

The Three Groups of CE Students Plus the Two Comparison Groups of Needy Non-CE Students in CE and in Non-CE Schools. These groups prove to be more comparable with one another than in the preceding case.

The Three Groups of CE Students Plus a Comparison Group that Consists of Needy Non-CE Students in Non-CE Schools with High Concentrations of Low-Achieving and Poverty Students. This comparison group is selected because its students come from non-CE schools with characteristics similar to those of CE schools.

The Group of All CE Students and the Two Comparison Groups of Needy Non-CE Students.

In each analysis, the pretest score serves as the covariate, and the posttest score is the dependent variable. The most important task in the implementation of Porter's method is to obtain a reasonable estimate of the pretest reliability. Unfortunately, accurate estimates are often not available. The best recommendation to date is to try the same analysis on a range of reliability estimates. If the analyses converge to the same results, we would have reasonable confidence in the findings. Accordingly, we decided to do the analyses using values from .6 to 1.0 (no correction) in steps of .10 as the correction factors. This range is selected on the basis of the reliability estimates computed previously for the CTBS tests (see Chapter 1 of Report 9).

For each set of the ANCOVA, supplementary analyses that examine differences in pretest means and the validity of the assumption of homogeneous within-group regressions were performed. Their results are provided in this report so that the readers may make their own judgments on the validity of the ANCOVA results. Even under the situation where within-group regressions are heterogeneous, one may still be able to extract information from the adjusted group means obtained with the ANCOVA.

Specifically, according to Rubin's (1976, 1977) definition (i.e., the treatment effect is the difference between the expected means in the population under the treatment and the control conditions), the treatment effects can be evaluated by comparing the adjusted group means computed with a common regression coefficient that is a weighted composite of the heterogeneous regression coefficients. When the within-group regressions are homogeneous, the comparison would be equivalent to the test of equality of adjusted group means in the ANCOVA. On the other hand, when the within-group regressions are unequal, the differences in regression coefficients may be examined to further our understanding of the group differences in general. The consequences of violating the equal-slope assumption vary depending on the pattern of differences among the slopes and the covariate means. In many cases, the adjusted group means may still be compared to obtain some approximations of the treatment effects. Under the condition of heterogeneous regressions, the estimated common regression coefficient with the ANCOVA model is actually also a weighted composite of the unequal within-group coefficients, though it may not correspond to that required in the calculation of treatment effects under Rubin's model (essentially, in Rubin's case, sample Ns constitute the weights).

Additionally, one should also recognize that if the covariate means differ insubstantially, violations of the ANCOVA assumptions may often be inconsequential. Under this circumstance, the primary function of the ANCOVA model is to remove the error variances due to variations of the concomitant variable, and thus provide a more sensitive test for the treatment effects.

The results for the first three sets of ANCOVAs invariably indicate violations of the equal-slope assumption. These results are summarized in Tables B3-1 through B3-6. As explained in Lindley (1957), when the sample is large, significant differences may be obtained even if the data indeed give greater support to the null hypothesis than other specific alternative hypotheses. Because of the extremely large samples involved in our analyses, the F-ratios are very sensitive to violations of the assumption. For this and other reasons given earlier, the reader may wish to study the data in this Appendix to gather some useful information, but should do so with caution.

Table B3-1

Mean Reading and Math Achievement Scores and Within-Group Regressions of Posttest on Pretest Scores by CE Status*

Grade		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Non-CE Students in Title I Schools	Non-CE Students in Other-CE Schools**	Students in Non-CE Schools**
				Reading			
Grade 1	N	2,785	987	574	2,115	967	585
Fall (Pretest)	Mean	323.73	337.21	336.03	348.86	358.05	341.15
Spring (Posttest)	Mean	382.96	396.81	390.21	416.70	423.04	408.02
Within-Group Slope		.75	.94	.80	.87	.99	.81
Grade 2	N	3,036	948	704	1,754	820	569
Fall (Pretest)	Mean	380.63	405.50	387.82	427.23	440.40	413.91
Spring (Posttest)	Mean	423.30	446.81	433.78	470.79	483.08	454.27
Within-Group Slope		.70	.84	.70	.87	.77	.82
Grade 3	N	3,022	884	629	1,761	836	581
Fall (Pretest)	Mean	415.43	442.48	428.67	471.61	485.74	460.34
Spring (Posttest)	Mean	450.74	473.04	463.22	503.73	517.94	494.83
Within-Group Slope		.73	.81	.77	.87	.84	.86
Grade 4	N	2,392	864	619	1,876	940	564
Fall (Pretest)	Mean	439.74	463.73	455.53	506.45	519.57	496.46
Spring (Posttest)	Mean	471.09	492.20	484.89	535.84	549.11	528.70
Within-Group Slope		.70	.90	.78	.88	.86	.89
Grade 5	N	2,227	802	587	1,992	1,041	651
Fall (Pretest)	Mean	465.46	496.68	478.11	535.32	546.69	525.53
Spring (Posttest)	Mean	490.65	520.57	505.99	562.45	575.66	555.59
Within-Group Slope		.79	.93	.84	.93	.95	.91
Grade 6	N	1,982	905	620	1,992	1,712	751
Fall (Pretest)	Mean	489.77	520.53	496.84	569.35	574.47	553.87
Spring (Posttest)	Mean	515.78	547.38	517.86	596.21	597.81	578.46
Within-Group Slope		.78	.92	.84	.92	.92	.94
				Math			
Grade 1	N	1,598	855	329	2,468	1,014	620
Fall (Pretest)	Mean	309.33	325.62	324.98	331.25	339.21	329.16
Spring (Posttest)	Mean	370.90	382.82	387.44	394.27	400.62	388.23
Within-Group Slope		.73	.70	.89	.86	.84	.78
Grade 2	N	1,686	808	291	2,207	938	558
Fall (Pretest)	Mean	362.41	386.12	380.94	395.27	405.81	389.02
Spring (Posttest)	Mean	415.87	440.09	435.30	451.78	463.56	445.28
Within-Group Slope		.70	.77	.88	.83	.81	.82
Grade 3	N	1,793	768	369	2,126	932	590
Fall (Pretest)	Mean	407.76	431.02	425.93	447.86	460.32	446.47
Spring (Posttest)	Mean	463.12	480.82	472.24	503.40	520.32	504.35
Within-Group Slope		.69	.73	.99	.80	.90	.84
Grade 4	N	1,434	845	373	2,178	964	580
Fall (Pretest)	Mean	444.94	473.26	466.94	498.62	514.05	491.68
Spring (Posttest)	Mean	498.32	518.52	500.82	549.38	565.16	541.67
Within-Group Slope		.74	.88	.79	.83	.88	.89
Grade 5	N	1,331	768	400	2,266	1,113	653
Fall (Pretest)	Mean	486.74	520.44	496.61	544.48	554.65	537.65
Spring (Posttest)	Mean	530.59	558.12	538.79	587.31	601.16	583.68
Within-Group Slope		.73	.87	.81	.92	.91	.91
Grade 6	N	1,134	858	457	2,272	1,711	757
Fall (Pretest)	Mean	526.54	551.31	525.29	584.59	592.71	581.81
Spring (Posttest)	Mean	570.57	590.50	561.47	624.73	633.85	620.22
Within-Group Slope		.72	.88	.84	.91	.93	.95

* Test of equality of slopes among the groups shows significant differences at .01 level in all cases.

** A random sample from all non-CE students was obtained to supply the data for these groups.

Table B3-2

ANCOVA of Reading and Math Scores for the Six CE Groups with Unreliability Corrections for the Pretest Scores

GRADE	Reliability Estimate	CE Status							
		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Non-CE Students in Title I Schools*	Non-CE Students in Other-CE Schools*	Students in Non-CE Schools*	Common Regression Coefficient	F
		Adjusted Group Means - Reading							
1	1.0	395.30	397.74	392.14	407.79	406.36	405.63	.85	41.98
	.9	396.67	397.85	392.36	406.80	404.51	405.36	.94	29.35
	.8	398.38	397.98	392.63	405.56	402.19	405.03	1.06	18.56
	.7	400.58	398.15	392.97	403.97	399.21	404.60	1.21	12.08
	.6	403.52	398.37	393.43	401.85	395.24	404.03	1.41	14.42
2	1.0	441.10	445.17	445.96	452.17	454.17	446.05	.78	28.80
	.9	443.08	444.99	447.31	450.10	450.95	445.14	.87	11.32
	.8	445.55	444.76	449.00	447.51	446.94	444.00	.98	2.67**
	.7	448.73	444.47	451.18	444.19	441.77	442.53	1.12	9.28
	.6	452.96	444.08	454.08	439.75	434.89	440.57	1.30	41.52
3	1.0	473.33	473.82	475.14	481.00	483.81	481.20	.81	20.80
	.9	475.84	473.90	476.46	478.47	480.02	479.68	.90	4.84
	.8	478.98	474.01	478.12	475.32	475.28	477.79	1.01	4.68
	.7	483.02	474.15	480.25	471.26	469.19	475.36	1.15	30.18
	.6	488.40	474.33	483.09	465.85	461.06	472.11	1.34	96.08
4	1.0	501.18	502.35	501.86	510.49	512.87	511.66	.83	23.38
	.9	504.52	503.48	503.75	507.67	508.84	509.77	.92	4.65
	.8	508.70	504.89	506.10	504.15	503.80	507.40	1.04	3.95
	.7	514.07	506.70	509.13	499.62	497.33	504.36	1.19	32.25
	.6	521.23	509.12	513.17	493.59	488.70	500.30	1.38	105.55
5	1.0	526.79	528.82	530.83	536.18	539.23	538.06	.89	25.49
	.9	530.81	529.74	533.59	533.26	535.18	536.11	.99	4.69
	.8	535.83	530.89	537.04	529.61	530.12	533.67	1.12	8.42
	.7	542.28	532.36	541.48	524.92	523.61	530.54	1.28	51.37
	.6	550.89	534.32	547.39	518.66	514.94	526.37	1.49	154.92
6	1.0	558.84	562.97	554.60	568.19	565.23	564.28	.89	20.66
	.9	563.63	564.70	558.68	565.08	561.60	562.70	.99	4.92
	.8	569.61	566.87	563.79	561.19	557.08	560.73	1.12	22.17
	.7	577.30	569.65	570.35	556.19	551.26	558.20	1.28	91.22
	.6	587.56	573.36	579.10	549.51	543.50	554.82	1.49	239.05
		Adjusted Group Means - Math							
1	1.0	384.36	383.24	388.38	390.18	390.17	385.82	.80	9.14
	.9	385.86	383.28	388.48	389.73	389.00	385.55	.89	5.86
	.8	387.73	383.34	388.61	389.16	387.55	385.22	1.00	4.14
	.7	390.13	383.42	388.78	388.43	385.69	384.79	1.14	5.61
	.6	393.34	383.52	389.00	387.46	383.20	384.22	1.33	13.27
2	1.0	434.46	439.94	439.25	444.40	447.84	442.84	.79	18.92
	.9	436.53	439.93	439.69	443.58	446.10	442.57	.88	9.56
	.8	439.11	439.91	440.24	442.55	443.92	442.23	.99	2.56**
	.7	442.43	439.88	440.94	441.23	441.11	441.80	1.13	.53**
	.6	446.86	439.85	441.88	439.48	437.37	441.21	1.32	8.37
3	1.0	485.01	484.27	479.73	493.50	500.54	495.55	.79	28.66
	.9	487.45	484.66	480.56	492.40	498.35	494.58	.88	17.49
	.8	490.49	485.14	481.60	491.02	495.60	493.36	.99	9.74
	.7	494.40	485.75	482.94	489.25	492.07	491.78	1.13	8.80
	.6	499.61	486.58	484.73	486.90	487.36	489.69	1.32	20.64
4	1.0	529.96	526.64	514.19	536.43	539.38	534.48	.83	26.71
	.9	533.48	527.54	515.68	534.99	536.51	533.68	.92	17.98
	.8	537.88	528.67	517.53	533.19	532.93	532.68	1.04	16.13
	.7	543.53	530.12	519.92	530.88	528.33	531.40	1.19	26.60
	.6	551.06	532.05	523.11	527.79	522.19	529.69	1.38	58.40
5	1.0	566.62	564.73	566.21	572.92	577.89	575.25	.87	12.51
	.9	570.63	565.46	569.26	571.32	575.30	574.32	.97	5.08
	.8	575.63	566.38	573.07	569.33	572.07	573.15	1.09	5.38
	.7	582.07	567.56	577.96	566.76	567.92	571.64	1.25	19.36
	.6	590.65	569.13	584.49	563.33	562.38	569.64	1.46	57.08
6	1.0	608.53	606.48	600.54	611.19	613.11	609.15	.89	6.55
	.9	612.75	608.26	604.88	609.69	610.80	607.92	.99	2.65**
	.8	618.02	610.48	610.31	607.81	607.92	606.38	1.11	8.40
	.7	624.80	613.33	617.29	605.39	604.22	604.41	1.27	30.93
	.6	633.84	617.14	626.59	602.17	599.28	601.77	1.48	82.31

* A random sample from all non-CE students was obtained to supply the data for these groups.
** Adjusted Group Means do not differ significantly among the groups at .01 level.

Table B3-3

Mean Reading and Math Achievement Scores and Within-Group Regressions of Posttest on Pretest Scores for the Three Categories of CE Students and the Two Comparison Groups of Needy Non-CE Students*

Grade		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Needy Non-CE Students in CE Schools	Needy Non-CE Students in Non-CE Schools
				Reading		
Grade 1	N	2,785	987	574	1,999	541
Fall (Pretest)	Mean	323.73	337.21	336.03	323.35	321.99
Spring (Posttest)	Mean	382.96	396.81	390.21	378.18	374.78
Within-Group Slope		.75	.94	.80	.62	.62
Grade 2	N	3,036	948	704	1,572	678
Fall (Pretest)	Mean	380.63	405.50	387.82	382.50	377.55
Spring (Posttest)	Mean	423.30	446.81	433.78	422.28	415.96
Within-Group Slope		.70	.84	.70	.72	.58
Grade 3	N	3,022	884	629	1,473	591
Fall (Pretest)	Mean	415.43	442.48	428.67	422.83	416.96
Spring (Posttest)	Mean	450.74	473.04	463.22	456.94	446.45
Within-Group Slope		.73	.81	.77	.75	.62
Grade 4	N	2,392	864	619	1,729	613
Fall (Pretest)	Mean	439.74	463.73	455.53	451.55	445.25
Spring (Posttest)	Mean	471.09	492.20	484.89	481.65	475.51
Within-Group Slope		.70	.90	.78	.73	.81
Grade 5	N	2,227	802	587	1,899	548
Fall (Pretest)	Mean	465.46	496.68	478.11	478.23	463.57
Spring (Posttest)	Mean	490.65	520.57	505.99	502.97	486.17
Within-Group Slope		.79	.93	.84	.82	.83
Grade 6	N	1,982	905	620	2,124	676
Fall (Pretest)	Mean	489.77	520.53	496.84	509.73	493.57
Spring (Posttest)	Mean	515.78	547.38	517.86	533.61	518.71
Within-Group Slope		.78	.92	.84	.81	.82
				Math		
Grade 1	N	1,598	855	329	1,599	1,051
Fall (Pretest)	Mean	309.33	325.62	324.98	304.20	307.25
Spring (Posttest)	Mean	370.90	382.82	387.44	358.33	356.38
Within-Group Slope		.73	.70	.89	.61	.56
Grade 2	N	1,686	808	291	1,353	1,035
Fall (Pretest)	Mean	362.41	386.12	380.94	361.38	360.14
Spring (Posttest)	Mean	415.87	440.09	435.30	411.85	406.89
Within-Group Slope		.70	.77	.88	.70	.67
Grade 3	N	1,793	768	369	1,370	1,057
Fall (Pretest)	Mean	407.76	431.02	425.93	407.20	404.99
Spring (Posttest)	Mean	463.12	480.82	472.24	456.27	455.10
Within-Group Slope		.69	.73	.99	.71	.59
Grade 4	N	1,434	845	373	1,455	1,169
Fall (Pretest)	Mean	444.94	473.26	466.94	450.27	448.04
Spring (Posttest)	Mean	498.32	518.52	500.82	498.49	495.01
Within-Group Slope		.74	.88	.79	.74	.76
Grade 5	N	1,331	768	400	1,606	1,270
Fall (Pretest)	Mean	486.74	520.44	496.61	490.84	487.28
Spring (Posttest)	Mean	530.59	558.12	538.79	529.69	523.03
Within-Group Slope		.73	.87	.81	.74	.78
Grade 6	N	1,134	858	457	1,767	1,321
Fall (Pretest)	Mean	526.54	551.31	525.29	530.80	524.41
Spring (Posttest)	Mean	570.57	590.50	561.47	566.23	558.14
Within-Group Slope		.72	.88	.84	.75	.77

*Within-Group Slopes differ significantly among categories at the .01 level in all cases.

Table B3-4

ANCOVA of Reading and Math Achievement Scores for the Three Groups of CE Students and Two Comparison Groups of Needy Non-CE Students with Unreliability Corrections for the Pretest Scores

GRADE	Reliability Estimate	CE Status					Common Regression Coefficient*	F
		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Needy Non-CE Students in CE Schools	Needy Non-CE Students in Non-CE Schools		
		Adjusted Group Means - Reading						
1	1.0	384.96	388.85	383.13	380.46	378.07	.74	14.23
	.9	385.18	387.97	382.34	380.71	378.43	.82	11.99
	.8	385.46	386.87	381.36	381.03	378.89	.92	10.04
	.7	385.82	385.45	380.09	381.44	379.48	1.05	8.90
	.6	386.29	383.56	378.41	381.98	380.26	1.23	9.66
2	1.0	426.34	432.05	431.67	423.99	421.21	.72	16.41
	.9	426.68	430.40	431.44	424.18	421.79	.80	11.78
	.8	427.10	428.35	431.15	424.42	422.52	.90	8.01
	.7	427.65	425.72	430.77	424.72	423.46	1.02	6.27
	.6	428.37	422.20	430.27	425.13	424.71	1.19	9.10
3	1.0	455.73	457.79	458.31	456.39	450.29	.75	6.21
	.9	456.28	456.10	457.76	456.33	450.72	.83	4.58
	.8	456.98	453.98	457.08	456.26	451.25	.94	4.98
	.7	457.87	451.26	456.21	456.16	451.94	1.07	9.31
	.6	459.06	447.63	455.04	456.03	452.86	1.25	21.32
4	1.0	477.82	480.45	479.46	479.28	477.99	.77	1.11**
	.9	478.57	479.14	478.86	479.02	478.26	.86	.10**
	.8	479.50	477.51	478.10	478.69	478.61	.96	.57**
	.7	480.70	475.41	477.13	478.27	479.05	1.10	3.90
	.6	482.30	472.61	475.84	477.70	479.64	1.28	12.89
5	1.0	498.32	502.18	503.10	499.97	495.41	.83	5.37
	.9	499.17	500.14	502.78	499.64	496.44	.93	2.52**
	.8	500.23	497.58	502.38	499.23	497.72	1.04	2.28**
	.7	501.60	494.30	501.86	498.69	499.37	1.19	7.14
	.6	503.43	489.92	501.17	497.98	501.57	1.39	22.06
6	1.0	525.91	532.06	522.13	527.22	525.68	.83	8.54
	.9	527.03	530.35	522.60	526.51	526.46	.92	4.75
	.8	528.44	528.22	523.19	525.63	527.43	1.03	3.87
	.7	530.25	525.49	523.96	524.49	528.68	1.18	8.80
	.6	532.66	521.84	524.97	522.97	530.34	1.38	25.31
		Adjusted Group Means - Math						
1	1.0	371.98	372.88	377.94	362.88	358.87	.68	41.11
	.9	372.10	371.77	376.88	363.39	359.15	.75	35.79
	.8	372.25	370.39	375.56	364.02	359.49	.85	30.35
	.7	372.44	368.62	373.87	364.83	359.94	.97	25.24
	.6	372.70	366.25	371.61	365.92	360.53	1.13	21.56
2	1.0	418.76	425.92	424.86	415.48	411.41	.72	19.83
	.9	419.08	424.35	423.70	415.89	411.92	.80	14.67
	.8	419.48	422.38	422.25	416.39	412.55	.90	9.77
	.7	420.00	419.86	420.39	417.04	413.35	1.03	5.89
	.6	420.68	416.48	417.90	417.91	414.43	1.20	4.69
3	1.0	465.90	467.04	462.08	459.45	459.84	.71	8.75
	.9	466.20	465.51	460.96	459.80	460.37	.79	7.29
	.8	466.59	463.59	459.54	460.24	461.03	.89	6.72
	.7	467.09	461.13	457.73	460.81	461.87	1.02	7.94
	.6	467.75	457.85	455.31	461.56	463.00	1.19	12.77
4	1.0	504.74	502.88	490.11	500.76	499.02	.78	10.04
	.9	505.46	501.15	488.92	501.01	499.47	.87	11.86
	.8	506.35	498.97	487.43	501.33	500.02	.97	15.59
	.7	507.49	496.18	485.52	501.74	500.74	1.11	22.68
	.6	509.02	492.46	482.97	502.[illegible]3	501.70	1.30	35.80
5	1.0	535.95	537.27	536.48	531.88	527.98	.78	8.52
	.9	536.55	534.95	536.23	532.12	528.53	.86	6.71
	.8	537.30	532.06	535.90	532.42	529.21	.97	6.31
	.7	538.25	528.33	535.49	532.81	530.10	1.11	8.69
	.6	539.53	523.37	534.94	533.33	531.28	1.30	16.58
6	1.0	574.16	574.67	566.04	566.49	563.41	.78	14.23
	.9	574.56	572.91	566.55	566.52	563.59	.87	11.82
	.8	575.06	570.71	567.19	566.55	564.72	.98	10.03
	.7	575.71	567.88	568.00	566.60	565.66	1.12	9.66
	.6	576.56	564.12	569.09	566.66	566.92	1.31	12.44

*Test of equality of slopes among the groups shows significant differences at .01 level in all cases.

**Adjusted group means do not differ significantly among the groups at .01 level.

Table B3-5

Mean Reading and Math Achievement Scores and Within-Group Regressions of Posttest on Pretest Scores for the Three Groups of CE Students and a Comparison Group of Needy Non-CE Students

Grade		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Comparison Group*
			Reading		
Grade 1	N	2,785	987	574	342
Fall (Pretest)	Mean	323.73	337.21	336.03	316.67
Spring (Posttest)	Mean	382.96	396.81	390.21	366.55
Within-Group Slope		.75	.94	.80	.62
Grade 2	N	3,036	948	704	458
Fall (Pretest)	Mean	380.63	405.50	387.82	373.42
Spring (Posttest)	Mean	423.30	446.81	433.78	410.58
Within-Group Slope		.70	.84	.70	.54
Grade 3	N	3,022	884	629	404
Fall (Pretest)	Mean	415.43	442.48	428.67	411.72
Spring (Posttest)	Mean	450.74	473.04	463.22	438.45
Within-Group Slope		.73	.81	.77	.54
Grade 4	N	2,392	864	619	375
Fall (Pretest)	Mean	439.74	463.73	455.53	431.68
Spring (Posttest)	Mean	471.09	492.20	484.89	463.64
Within-Group Slope		.70	.90	.78	.73
Grade 5	N	2,227	802	587	381
Fall (Pretest)	Mean	465.46	496.68	478.11	457.78
Spring (Posttest)	Mean	490.65	520.57	505.99	481.67
Within-Group Slope		.79	.93	.84	.79
Grade 6	N	1,982	905	620	369
Fall (Pretest)	Mean	489.77	520.53	496.84	477.52
Spring (Posttest)	Mean	515.78	547.38	517.86	500.86
Within-Group Slope		.78	.92	.84	.74
			Math		
Grade 1	N	1,598	855	329	539
Fall (Pretest)	Mean	309.33	325.62	324.98	304.23
Spring (Posttest)	Mean	370.90	382.82	387.44	349.18
Within-Group Slope		.73	.70	.89	.55
Grade 2	N	1,686	808	291	608
Fall (Pretest)	Mean	362.41	386.12	380.94	360.36
Spring (Posttest)	Mean	415.87	440.09	435.30	405.67
Within-Group Slope**		.70	.77	.88	.71
Grade 3	N	1,793	768	369	589
Fall (Pretest)	Mean	407.76	431.02	425.93	402.74
Spring (Posttest)	Mean	463.12	480.82	472.24	450.16
Within-Group Slope		.69	.73	.99	.55
Grade 4	N	1,434	845	373	661
Fall (Pretest)	Mean	444.94	473.26	466.94	441.77
Spring (Posttest)	Mean	498.32	518.52	500.82	489.54
Within-Group Slope		.74	.88	.79	.76
Grade 5	N	1,331	768	400	732
Fall (Pretest)	Mean	486.74	520.44	496.61	484.11
Spring (Posttest	Mean	530.59	558.12	538.79	517.79
Within-Group Slope		.73	.87	.81	.83
Grade 6	N	1,134	858	457	649
Fall (Pretest)	Mean	526.54	551.31	525.29	515.21
Spring (Posttest)	Mean	570.57	590.50	561.47	550.48
Within-Group Slope		.72	.88	.84	.85

*This comparison group comprises non-CE students who were judged to be in need of reading (math) CE and attended non-CE schools with high concentrations of reading (math) low-achieving students and free-meal participants.

**Slopes do not differ significantly among the groups at .01 level.

Table B3-6

ANCOVA of Reading and Math Achievement Scores for the Three Groups of Reading (Math) CE Students and a Comparison Group of Needy Non-CE Students, with Unreliability Corrections for Pretest Scores

		CE Status					
Grade	Reliability Estimate	Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Comparison Group*	Common Regression Coefficient	F
			Adjusted Group Means - Reading				
1	1.0	385.97	389.22	383.54	375.12	.79	14.33
	.9	386.31	388.38	382.81	376.06	.87	12.05
	.8	386.73	387.32	381.88	377.25	.98	10.39
	.7	387.26	385.97	380.69	378.78	1.12	10.17
	.6	387.98	384.16	379.11	380.82	1.31	13.01
2	1.0	426.83	432.52	432.16	419.28	.72	19.64
	.9	427.22	430.93	431.98	420.25	.80	13.54
	.8	427.71	428.94	431.75	421.45	.90	8.67
	.7	428.34	426.39	431.46	423.01	1.02	6.56
	.6	429.18	422.99	431.07	425.08	1.19	10.49
3	1.0	455.37	457.52	457.99	445.85	.75	14.65
	.9	455.89	455.80	457.41	446.67	.83	11.26
	.8	456.53	453.64	456.69	447.70	.93	10.45
	.7	457.36	450.87	455.76	449.02	1.06	14.73
	.6	458.46	447.18	454.51	450.79	1.24	28.99
4	1.0	476.11	478.60	477.66	474.91	.78	1.41**
	.9	476.67	477.09	476.86	476.16	.86	.06**
	.8	477.36	475.20	475.85	477.73	.97	.92**
	.7	478.26	472.78	474.56	479.74	1.11	5.94
	.6	479.45	469.54	472.84	482.42	1.29	18.96
5	1.0	496.85	500.61	501.59	494.30	.84	5.79
	.9	497.53	498.39	501.10	495.70	.93	2.30**
	.8	498.39	495.61	500.48	497.46	1.05	2.40**
	.7	499.50	492.05	499.70	499.71	1.20	9.32
	.6	500.97	487.29	498.65	502.72	1.40	29.25
6	1.0	521.73	527.74	517.92	517.00	.83	13.08
	.9	522.39	525.56	517.92	518.79	.92	6.89
	.8	523.21	522.83	517.93	521.03	1.04	3.89
	.7	524.28	519.32	517.94	523.91	1.19	7.32
	.6	525.69	514.64	517.96	527.76	1.39	23.53
			Adjusted Group Means - Math				
1	1.0	374.37	374.78	379.86	356.25	.71	43.27
	.9	374.76	373.89	379.02	357.04	.78	38.85
	.8	375.24	372.77	377.97	358.02	.88	34.42
	.7	375.86	371.34	376.61	359.28	1.01	30.54
	.6	376.69	369.43	374.81	360.97	1.18	28.33
2	1.0	420.93	427.66	426.69	412.26	.74	19.53
	.9	421.50	426.27	425.73	412.99	.82	14.52
	.8	422.20	424.55	424.54	413.90	.92	9.97
	.7	423.11	422.33	423.00	415.08	1.05	6.80
	.6	424.31	419.37	420.95	416.65	1.23	6.91
3	1.0	467.53	468.53	463.60	458.18	.72	9.44
	.9	468.02	467.16	462.64	459.07	.80	8.21
	.8	468.64	465.45	461.44	460.18	.90	8.10
	.7	469.42	463.25	459.90	461.61	1.03	10.17
	.6	470.47	460.33	457.84	463.52	1.20	16.51
4	1.0	505.51	503.23	490.56	499.26	.79	13.31
	.9	506.31	501.54	489.42	500.34	.88	15.86
	.8	507.31	499.41	487.99	501.69	.99	21.06
	.7	508.60	496.68	486.16	503.43	1.13	30.82
	.6	510.31	493.04	483.71	505.74	1.32	48.60
5	1.0	537.53	537.98	537.80	526.85	.80	12.14
	.9	538.30	535.74	537.69	527.85	.89	10.08
	.8	539.26	532.94	537.55	529.11	1.00	10.11
	.7	540.50	529.34	537.38	530.73	1.15	14.15
	.6	542.15	524.55	537.14	532.89	1.34	25.90
6	1.0	574.09	573.75	566.01	563.27	.82	10.92
	.9	574.48	571.89	566.51	564.69	.91	8.03
	.8	574.97	569.57	567.14	566.47	1.02	6.50
	.7	575.59	566.58	567.95	568.75	1.17	7.79
	.6	576.43	562.59	569.03	571.80	1.36	14.85

*This comparison group comprises non-CE students who were judged to be in need of reading (math) CE and attended non-CE schools with high concentrations of reading (math) low-achieving students and free-meal participants.

**Adjusted group means do not differ significantly among the groups at .01 level.

In the last set of analyses, the equality of within-group slopes is insignificant in grades 4 to 6 for reading and in grades 2 and 4 through 6 for math. The supplementary information and the ANCOVA results for this set of analyses are presented in Tables B3-7 and B3-8. The data in Table B3-7 show that in the grades where the equal-slope assumption is not met, the differences in pretest means among the three groups are modest. Consequently, the F-tests for the differences in adjusted group means can still be referenced to assess the effects of CE. Disregarding the significances of unequal within-group regressions, we find from Table B3-8 that consistently greater gains for CE students are obtained in grades 1 through 3 for reading and for all grades but grade 4 for math. (In grade 3, this finding applies when the pretest reliability is greater than .8. Judging from the data presented in Table 1-15 of Report 9, the reliability for the math pretest in this grade is in the vicinity of .7 to .8.) Our conclusion is that despite the violations of the assumption, the ANCOVAs, in effect, give similar results as in the previous ANOVAs, and their findings do not contradict the findings of the norm-referenced analyses: Title I students do better than if they were not in the program, but not well enough to catch-up.

In closing, we comment that examination of the within-group regression coefficients in Table B3-3 indicates that the significant inequality of slopes mostly reflects the steeper slope for other-CE students in Title I schools. In light of the pattern of differences in slopes among the groups, one may consider reanalyses of the data using only Title I students and the two non-CE comparison groups. However, we have no great expectation for the findings in these revised analyses to be very different from those presented in Table B3-8, as Title I students generally dominate the group of CE students.

Analysis for Practical Achievement.

The results of the analyses for practical achievement scores are tabulated in Tables B3-9 to B3-16 for grades 4 through 6 (the three grades at which the practical achievement scale was administered. A brief summary of the findings from these analyses is provided in the text.

Analysis for Student's Attitudes Toward Learning and School

The results of the analyses for student affect scores are presented in Tables B3-17 through B3-24, while the findings from these analyses are summarized in the text.

Table B3-7

Mean Reading and Math Achievement Scores and Within-Group Regressions of Posttest on Pretest Scores for CE Students and Two Comparison Groups of Needy Non-CE Students

Grade		CE Students	Needy Non-CE Students in CE Schools	Needy Non-CE Students in Non-CE Schools
		Reading		
Grade 1	N	4,346	1,999	541
Fall (Pretest)	Mean	328.29	323.35	321.99
Spring (Posttest)	Mean	386.93	378.18	374.78
Within-Group Slope		.80	.62	.62
Grade 2	N	4,688	1,572	678
Fall (Pretest)	Mean	386.60	392.50	377.55
Spring (Posttest)	Mean	429.50	422.28	415.96
Within-Group Slope		.75	.72	.58
Grade 3	N	4,535	1,473	591
Fall (Pretest)	Mean	422.41	422.83	416.96
Spring (Posttest)	Mean	456.69	456.94	446.45
Within-Group Slope		.76	.75	.62
Grade 4	N	3,875	1,729	613
Fall (Pretest)	Mean	447.50	451.55	445.25
Spring (Posttest)	Mean	477.89	481.65	475.51
Within-Group Slope *		.78	.73	.81
Grade 5	N	3,616	1,899	548
Fall (Pretest)	Mean	474.33	478.23	463.57
Spring (Posttest)	Mean	499.67	502.97	486.17
Within-Group Slope *		.85	.82	.83
Grade 6	N	3,507	2,124	676
Fall (Pretest)	Mean	498.84	509.73	493.57
Spring (Posttest)	Mean	524.19	533.61	518.71
Within-Group Slope *		.85	.81	.82
		Math		
Grade 1	N	2,782	1,599	1,051
Fall (Pretest)	Mean	316.10	304.20	307.25
Spring (Posttest)	Mean	376.43	358.33	356.38
Within-Group Slope		.74	.61	.56
Grade 2	N	2,785	1,353	1,035
Fall (Pretest)	Mean	371.14	361.38	360.14
Spring (Posttest)	Mean	424.84	411.85	406.89
Within-Group Slope *		.76	.70	.67
Grade 3	N	2,930	1,370	1,057
Fall (Pretest)	Mean	416.05	407.20	404.99
Spring (Posttest)	Mean	468.81	456.27	455.10
Within-Group Slope		.74	.71	.59
Grade 4	N	2,652	1,455	1,169
Fall (Pretest)	Mean	456.97	450.27	448.04
Spring (Posttest)	Mean	505.02	498.49	495.01
Within-Group Slope*		.79	.74	.76
Grade 5	N	2,499	1,606	1,270
Fall (Pretest)	Mean	498.59	490.84	487.28
Spring (Posttest)	Mean	540.27	529.69	523.03
Within-Group Slope*		.80	.74	.78
Grade 6	N	2,449	1,767	1,321
Fall (Pretest)	Mean	534.90	530.80	524.41
Spring (Posttest)	Mean	575.76	566.23	558.14
Within-Group Slope*		.81	.75	.77

*Slopes do not differ significantly among the groups at .01 level.

Table B3-8

ANCOVA of Reading and Math Achievement Scores for CE Students and Two Comparison Groups of Needy Non-CE Students with Unreliability Corrections for the Pretest Scores

		CE Status				
Grade	Reliability Estimate	CE Students	Needy Non-CE Students in CE Schools	Needy Non-CE Students in Non-CE Schools	Common Regression Coefficient	F
		Adjusted Group Means - Reading				
1	1.0	385.50	380.41	378.03	.74	21.86
	.9	385.34	380.66	378.39	.82	18.84
	.8	385.14	380.97	378.84	.93	15.06
	.7	384.88	381.37	379.42	1.06	10.83
	.6	384.54	381.90	380.19	1.24	6.30
2	1.0	428.18	423.94	421.21	.72	18.51
	.9	428.04	424.13	421.79	.81	15.39
	.8	427.85	424.36	422.52	.91	11.59
	.7	427.62	424.65	423.46	1.04	7.52
	.6	427.30	425.05	424.71	1.21	3.54*
3	1.0	456.39	456.33	450.24	.75	9.82
	.9	456.36	456.26	450.67	.84	8.48
	.8	456.32	456.17	451.20	.94	6.80
	.7	456.26	456.06	451.87	1.07	4.91
	.6	456.19	455.92	452.78	1.25	2.87*
4	1.0	478.59	479.22	477.94	.77	.34*
	.9	478.67	478.95	478.21	.86	.10*
	.8	478.76	478.61	478.55	.97	.02*
	.7	478.89	478.17	478.99	1.10	.26*
	.6	479.06	477.60	479.57	1.29	1.19*
5	1.0	499.88	499.90	495.41	.84	4.20*
	.9	499.90	499.56	496.44	.93	2.43*
	.8	499.93	499.14	497.73	1.05	1.11*
	.7	499.97	498.59	499.38	1.20	.98*
	.6	500.02	497.86	501.58	1.40	3.50*
6	1.0	526.77	527.12	525.68	.83	.44*
	.9	527.06	526.40	526.46	.93	.27*
	.8	527.42	525.50	527.43	1.04	2.14*
	.7	527.88	524.34	528.68	1.19	7.92
	.6	528.49	522.79	530.34	1.39	21.40
		Adjusted Group Means - Math				
1	1.0	372.88	362.88	358.86	.68	77.80
	.9	372.48	363.39	359.13	.76	68.36
	.8	371.99	364.02	359.47	.85	57.25
	.7	371.36	364.83	359.92	.97	44.87
	.6	370.51	365.92	360.51	1.13	31.69
2	1.0	421.36	415.51	411.45	.73	28.79
	.9	420.98	415.91	411.96	.81	23.33
	.8	420.50	416.42	412.60	.91	17.28
	.7	419.88	417.07	413.41	1.04	10.99
	.6	419.05	417.95	414.50	1.22	5.22
3	1.0	465.65	459.41	459.81	.71	15.35
	.9	465.30	459.76	460.33	.79	11.78
	.8	464.86	460.20	460.98	.89	7.89
	.7	464.29	460.76	461.82	1.02	4.11*
	.6	463.54	461.50	462.94	1.19	1.19*
4	1.0	502.06	500.71	498.96	.77	2.20*
	.9	501.73	500.96	499.40	.86	1.23*
	.8	501.32	501.27	499.94	.97	.46*
	.7	500.79	501.66	500.65	1.10	.25*
	.6	500.08	502.19	501.59	1.29	1.31*
5	1.0	536.38	531.85	527.95	.78	16.74
	.9	535.95	532.09	528.50	.87	12.97
	.8	535.41	532.39	529.19	.97	8.89
	.7	534.72	532.77	530.07	1.11	4.83
	.6	533.79	533.29	531.24	1.30	1.46*
6	1.0	572.77	566.46	563.39	.79	21.79
	.9	572.44	566.48	563.97	.87	18.18
	.8	572.02	566.52	564.70	.98	14.15
	.7	571.49	566.56	565.64	1.12	9.83
	.6	570.77	566.61	566.89	1.31	5.56

*Adjusted group means do not differ significantly among the groups at .01 level.

Table B3-9

Mean Practical Achievement Scores and Within-Group Regressions of Posttest on Pretest Scores for CE Students and Two Comparison Groups of Needy Non-CE Students

Grade		CE Students	Needy Non-CE Students in CE Schools	Needy Non-CE Students in Non-CE Schools
		Reading CE Status		
Grade 4	N	3,844	1,730	577
Fall (Pretest)	Mean	9.65	9.66	9.49
Spring (Posttest)	Mean	13.47	13.78	13.55
Within-Group Slope*		.76	.75	.65
Grade 5	N	3,592	1,874	521
Fall (Pretest)	Mean	13.19	13.31	12.48
Spring (Posttest)	Mean	16.37	16.65	15.55
Within-Group Slope*		.75	.71	.72
Grade 6	N	3,486	2,115	637
Fall (Pretest)	Mean	15.58	16.54	15.15
Spring (Posttest)	Mean	18.59	19.56	18.32
Within-Group Slope*		.72	.67	.73
		Math CE Status		
Grade 4	N	2,636	1,469	1,138
Fall (Pretest)	Mean	9.80	9.00	9.41
Spring (Posttest)	Mean	13.55	12.86	13.16
Within-Group Slope		.80	.67	.62
Grade 5	N	2,470	1,597	1,237
Fall (Pretest)	Mean	13.31	12.25	12.90
Spring (Posttest)	Mean	16.49	15.61	15.79
Within-Group Slope		.75	.71	.70
Grade 6	N	2,427	1,760	1,290
Fall (Pretest)	Mean	15.90	15.41	15.21
Spring (Posttest)	Mean	18.87	18.66	17.96
Within-Group Slope*		.70	.69	.73

* Slopes do not differ significantly among groups at .01 level.

Table B3-10

ANCOVA of Practical Achievement Scores for CE Students and Two Comparison Groups of Needy Non-CE Students with Unreliability Corrections for the Pretest Scores

		CE Status				
Grade	Reliability Estimate	CE Students	Needy Non-CE Students in CE Schools	Needy Non-CE Students in Non-CE Schools	Common Regression Coefficient	F
		Adjusted Group Means - Reading CE Status				
4	1.0	13.47	13.76	13.66	.75	2.39*
	.9	13.46	13.76	13.67	.83	2.41*
	.8	13.46	13.76	13.69	.94	2.44*
	.7	13.46	13.76	13.70	1.07	2.49*
	.6	13.46	13.75	13.73	1.25	2.56*
5	1.0	16.35	16.54	16.06	.73	2.09*
	.9	16.35	16.52	16.11	.82	1.62*
	.8	16.34	16.51	16.18	.92	1.12*
	.7	16.34	16.49	16.27	1.05	.66*
	.6	16.34	16.46	16.39	1.22	.36*
6	1.0	18.78	19.08	18.83	.71	2.55*
	.9	18.81	19.03	18.88	.78	1.26*
	.8	18.83	18.96	18.95	.88	.43*
	.7	18.87	18.87	19.04	1.01	.34*
	.6	18.92	18.76	19.16	1.18	1.92*
		Adjusted Group Means - Math CE Status				
4	1.0	13.32	13.23	13.22	.74	.27*
	.9	13.29	13.27	13.22	.82	.09*
	.8	13.26	13.32	13.23	.92	.11*
	.7	13.22	13.38	13.24	1.06	.53*
	.6	13.17	13.47	13.26	1.23	1.79*
5	1.0	16.19	16.08	15.78	.73	2.72*
	.9	16.15	16.14	15.78	.81	2.61*
	.8	16.11	16.20	15.78	.91	2.75*
	.7	16.06	16.29	15.78	1.05	3.58*
	.6	15.98	16.40	15.78	1.22	5.82
6	1.0	18.64	18.78	18.22	.70	5.14
	.9	18.62	18.79	18.25	.78	4.69
	.8	18.59	18.81	18.29	.87	4.26*
	.7	18.55	18.83	18.33	1.00	4.00*
	.6	18.50	18.85	18.39	1.17	4.14*

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*Adjusted group means do not differ significantly among groups at .01 level.

Table B3-11

Mean Practical Achievement Scores and Within-Group Regression of Posttest on Pretest Scores by CE Status

Grade		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Non-CE Students in Title I Schools*	Non-CE Students in Other-CE Schools*	Students in Non-CE Schools*
				Reading CE Status			
Grade 4	N	2,367	868	609	1,876	941	544
Fall (Pretest)	Mean	9.17	10.38	10.48	14.75	15.69	13.85
Spring (Posttest)	Mean	12.93	14.57	14.02	19.11	19.76	18.43
Within-Group Slope		.68	.90	.76	.75	.73	.74
Grade 5	N	2,218	798	576	1,989	1,032	635
Fall (Pretest)	Mean	12.39	14.90	13.89	18.67	19.78	18.32
Spring (Posttest)	Mean	15.55	18.36	16.80	21.58	22.86	21.39
Within-Group Slope**		.72	.76	.75	.71	.68	.65
Grade 6	N	1,979	894	613	1,980	1,700	731
Fall (Pretest)	Mean	14.94	17.05	15.54	21.52	22.08	20.56
Spring (Posttest)	Mean	17.92	20.01	18.72	23.79	24.12	22.82
Within-Group Slope		.69	.76	.73	.65	.62	.70
				Math CE Status			
Grade 4	N	1,426	844	366	2,173	968	561
Fall (Pretest)	Mean	8.83	10.91	11.01	13.87	15.62	13.17
Spring (Posttest)	Mean	12.53	14.96	14.26	18.26	19.48	17.75
Within-Group Slope		.67	.90	.82	.73	.76	.78
Grade 5	N	1,321	757	392	2,254	1,107	643
Fall (Pretest)	Mean	12.13	15.18	13.67	18.00	19.19	17.77
Spring (Posttest)	Mean	15.32	18.43	16.73	20.96	22.40	20.96
Within-Group Slope		.68	.77	.80	.73	.69	.66
Grade 6	N	1,138	839	450	2,272	1,705	743
Fall (Pretest)	Mean	15.01	17.33	15.50	20.65	21.63	20.40
Spring (Posttest)	Mean	17.92	20.16	18.89	22.97	23.67	22.72
Within-Group Slope		.64	.75	.68	.70	.67	.67

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*A random sample was selected from all non-CE students to supply the data for these groups.

**Slopes do not differ significantly among the six groups at .01 level.

Table B3-12

ANCOVA of Practical Achievement Scores for the Six Groups of CE Students with Unreliability Corrections for the Pretest Scores

GRADE	Reliability Estimate	CE Status						Common Regression Coefficient	F
		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Non-CE Students in Title I Schools*	Non-CE Students in Other-CE Schools*	Students in Non-CE Schools*		
		Adjusted Group Means - Reading CE Status							
4	1.0	15.12	15.85	15.22	17.12	17.06	17.11	.75	47.95
	.9	15.36	15.99	15.35	16.89	16.76	16.96	.83	27.57
	.8	15.67	16.17	15.52	16.62	16.38	16.77	.94	11.15
	.7	16.06	16.39	15.73	16.26	15.90	16.54	1.07	3.23
	.6	16.58	16.70	16.02	15.78	15.25	16.22	1.25	11.18
5	1.0	18.17	19.19	18.36	19.74	20.24	19.80	.71	36.56
	.9	18.46	19.29	18.53	19.53	19.95	19.62	.79	17.94
	.8	18.83	19.40	18.75	19.28	19.58	19.40	.89	4.87
	.7	19.29	19.55	19.03	18.95	19.11	19.12	1.01	2.24**
	.6	19.92	19.75	19.40	18.51	18.49	18.74	1.18	18.22
6	1.0	20.64	21.29	21.03	22.02	21.97	21.71	.68	22.50
	.9	20.95	21.44	21.28	21.83	21.74	21.58	.76	7.92
	.8	21.33	21.62	21.61	21.58	21.44	21.43	.85	1.00**
	.7	21.81	21.85	22.02	21.27	21.05	21.23	.98	7.25
	.6	22.46	22.15	22.57	20.85	20.54	20.96	1.14	35.61
		Adjusted Group Means - Math CE Status							
4	1.0	15.23	16.08	15.31	17.13	17.01	17.15	.76	34.96
	.9	15.53	16.20	15.43	17.01	16.74	17.08	.85	21.26
	.8	15.90	16.36	15.57	16.85	16.40	17.00	.95	10.35
	.7	16.38	16.56	15.76	16.65	15.96	16.89	1.09	5.76
	.6	17.03	16.83	16.01	16.38	15.37	16.75	1.27	13.48
5	1.0	18.38	19.30	18.68	19.80	20.39	19.97	.72	25.81
	.9	18.72	19.39	18.90	19.68	20.17	19.86	.80	12.60
	.8	19.15	19.51	19.17	19.52	19.89	19.72	.90	3.18
	.7	19.70	19.67	19.52	19.31	19.53	19.54	1.03	1.32**
	.6	20.43	19.88	19.99	19.03	19.05	19.31	1.20	13.70
6	1.0	20.82	21.47	21.45	22.01	22.03	21.93	.68	13.06
	.9	21.14	21.62	21.74	21.90	21.85	21.84	.76	4.71
	.8	21.54	21.80	22.09	21.77	21.62	21.73	.86	1.32**
	.7	22.06	22.03	22.55	21.60	21.33	21.59	.98	7.00
	.6	22.75	22.35	23.16	21.37	20.94	21.40	1.14	28.86

* A random sample was selected from all non-CE students to supply the data for these groups.
** Adjusted group means do not differ significantly among the six groups at .01 level.

Table B3-13

Mean Practical Achievement Scores and Within-Group Regressions of Posttest on Pretest Scores for the Three Groups of CE Students and Two Comparison Groups of Needy Non-CE Students

Grade		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Needy Non-CE Students in CE-Schools	Needy Non-CE Students in Non-CE Schools
			Reading CE Status			
Grade 4	N	2,367	868	609	1,730	577
Fall (Pretest)	Mean	9.17	10.38	10.48	9.66	9.49
Spring (Posttest)	Mean	12.93	14.57	14.02	13.78	13.55
Within-Group Slope		.68	.90	.76	.75	.65
Grade 5	N	2,218	798	576	1,874	521
Fall (Pretest)	Mean	12.39	14.90	13.89	13.31	12.48
Spring (Posttest)	Mean	15.55	18.36	16.80	16.65	15.55
Within-Group Slope *		.72	.76	.75	.71	.72
Grade 6	N	1,979	894	613	2,115	637
Fall (Pretest)	Mean	14.94	17.05	15.54	16.54	15.15
Spring (Posttest)	Mean	17.92	20.01	18.72	19.56	18.32
Within-Group Slope *		.69	.76	.73	.67	.73
			Math CE Status			
Grade 4	N	1,426	844	366	1,469	1,138
Fall (Pretest)	Mean	8.83	10.91	11.01	9.00	9.41
Spring (Posttest)	Mean	12.53	14.96	14.26	12.86	13.16
Within-Group Slope		.67	.90	.82	.67	.62
Grade 5	N	1,321	757	392	1,597	1,237
Fall (Pretest)	Mean	12.13	15.18	13.67	12.25	12.90
Spring (Posttest)	Mean	15.32	18.43	16.73	15.61	15.79
Within-Group Slope *		.68	.77	.80	.71	.70
Grade 6	N	1,138	839	450	1,760	1,290
Fall (Pretest)	Mean	15.01	17.33	15.50	15.41	15.21
Spring (Posttest)	Mean	17.92	20.16	18.89	18.66	17.96
Within-Group Slope *		.64	.75	.68	.69	.73

*Slopes do not differ significantly among the analysis groups at .01 level.

Table B3-14

ANCOVA of Practical Achievement Scores for the Three Groups of CE Students and Two Comparison Groups of Needy Non-CE Students with Unreliability Corrections for the Pretest Scores

Grade	Reliability Estimate	CE Status					Common Regression Coefficient	F
		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Needy Non-CE Students in CE-Schools	Needy Non-CE Students in Non-CE Schools		
		Adjusted Group Means - Reading CE Status						
4	1.0	13.28	14.02	13.39	13.76	13.66	.75	4.90
	.9	13.32	13.95	13.32	13.76	13.67	.83	4.10
	.8	13.37	13.88	13.23	13.76	13.68	.93	3.40
	.7	13.44	13.78	13.12	13.76	13.70	1.07	2.99*
	.6	13.52	13.65	12.97	13.75	13.73	1.24	3.30*
5	1.0	16.12	17.09	16.28	16.54	16.05	.73	6.67
	.9	16.18	16.95	16.22	16.53	16.11	.81	4.45
	.8	16.26	16.78	16.15	16.51	16.18	.91	2.46*
	.7	16.36	16.55	16.05	16.49	16.27	1.04	1.20*
	.6	16.49	16.25	15.93	16.47	16.39	1.21	1.72*
6	1.0	18.57	19.18	18.94	19.08	18.82	.70	3.89
	.9	18.64	19.09	18.97	19.03	18.88	.78	2.10*
	.8	18.73	18.97	19.00	18.96	18.95	.88	.78*
	.7	18.85	18.82	19.04	18.88	19.04	1.00	.38*
	.6	19.00	18.63	19.09	18.76	19.16	1.17	2.08*
		Adjusted Group Means - Math CE Status						
4	1.0	13.01	13.92	13.16	13.22	13.22	.73	4.98
	.9	13.06	13.81	13.03	13.26	13.22	.81	3.50
	.8	13.13	13.66	12.88	13.31	13.23	.91	2.36*
	.7	13.21	13.48	12.68	13.38	13.24	1.04	2.01*
	.6	13.33	13.23	12.42	13.46	13.25	1.22	3.41
5	1.0	15.88	16.77	16.17	16.08	15.78	.72	5.22
	.9	15.94	16.59	16.10	16.13	15.78	.80	3.32*
	.8	16.01	16.36	16.03	16.20	15.78	.90	1.96*
	.7	16.11	16.06	15.93	16.28	15.78	1.03	1.85*
	.6	16.25	15.67	15.79	16.39	15.78	1.21	4.41
6	1.0	18.32	18.94	18.94	18.78	18.22	.70	5.06
	.9	18.36	18.81	18.95	18.79	18.25	.77	3.95
	.8	18.42	18.64	18.96	18.81	18.29	.87	3.16*
	.7	18.49	18.42	18.97	18.83	18.33	.99	3.04*
	.6	18.58	18.13	18.98	18.86	18.39	1.16	4.43

*Adjusted group means do not differ significantly among the analysis groups at .01 level.

Table B3-15

Mean Practical Achievement Scores and Within-Group Regressions of Posttest on Pretest Scores for the Three Groups of CE Students and a Comparison Group of Needy Non-CE Students*

Grade		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students in Other-CE Schools	Comparison Group*
		Reading CE Status			
Grade 4	N	2,367	868	609	336
Fall (Pretest)	Mean	9.17	10.38	10.48	8.60
Spring (Posttest)	Mean	12.93	14.57	14.02	12.96
Within-Group Slope		.68	.90	.76	.54
Grade 5	N	2,218	798	576	355
Fall (Pretest)	Mean	12.39	14.90	13.89	12.29
Spring (Posttest)	Mean	15.55	18.36	16.80	15.65
Within-Group Slope**		.72	.76	.75	.74
Grade 6	N	1,979	894	613	329
Fall (Pretest)	Mean	14.94	17.05	15.54	13.81
Spring (Posttest)	Mean	17.92	20.01	18.72	16.65
Within-Group Slope**		.69	.76	.73	.67
		Math CE Status			
Grade 4	N	1,426	844	366	631
Fall (Pretest)	Mean	8.83	10.91	11.01	8.78
Spring (Posttest)	Mean	12.53	14.96	14.26	12.90
Within-Group Slope		.67	.90	.82	.55
Grade 5	N	1,321	757	392	702
Fall (Pretest)	Mean	12.13	15.18	13.67	12.69
Spring (Posttest)	Mean	15.32	18.43	16.73	15.48
Within-Group Slope**		.68	.77	.80	.70
Grade 6	N	1,138	839	450	618
Fall (Pretest)	Mean	15.01	17.33	15.50	14.26
Spring (Posttest)	Mean	17.92	20.16	18.89	17.08
Within-Group Slope		.64	.75	.68	.76

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*This comparison group comprises non-CE students who were judged to be in need of reading (math) CE and attended non-CE schools with high concentrations of reading (math) low-achieving students and free-meal participants.

**Slopes do not differ significantly among the groups at .01 level.

Table B3-16

ANCOVA of Practical Achievement Score for the Three Groups of CE Students and a Comparison Group of Needy Non-CE Students with Unreliability Corrections for the Pretest Score*

Grade	Reliability Estimate	CE Status: Title I Students in Title I Schools	CE Status: Other-CE Students in Title I Schools	CE Status: CE Students in Other-CE Schools	Comparison Group*	Common Regression Coefficient	F
		Adjusted Group Means - Reading CE Status					
4	1.0	13.23	13.96	13.33	13.68	.75	5.27
	.9	13.26	13.89	13.26	13.76	.83	4.43
	.8	13.31	13.81	13.16	13.85	.93	3.87
	.7	13.36	13.70	13.04	13.98	1.07	3.94
	.6	13.43	13.56	12.88	14.15	1.24	5.39
5	1.0	16.08	17.04	16.23	16.25	.74	7.17
	.9	16.14	16.89	16.16	16.31	.82	4.54
	.8	16.21	16.70	16.08	16.40	.92	2.36**
	.7	16.31	16.47	15.98	16.51	1.05	1.30**
	.6	16.43	16.15	15.84	16.65	1.23	2.81**
6	1.0	18.27	18.85	18.64	17.81	.72	5.02
	.9	18.31	18.72	18.63	17.94	.79	2.85**
	.8	18.36	18.56	18.62	18.10	.89	1.13**
	.7	18.42	18.36	18.61	18.31	1.02	.40**
	.6	18.51	18.08	18.58	18.58	1.19	1.94**
		Adjusted Group Means - Math CE Status					
4	1.0	13.11	13.96	13.19	13.52	.76	5.69
	.9	13.18	13.85	13.08	13.59	.85	4.26
	.8	13.26	13.72	12.93	13.68	.95	3.41**
	.7	13.36	13.54	12.74	13.79	1.09	3.82
	.6	13.50	13.30	12.48	13.94	1.27	6.80
5	1.0	16.08	16.96	16.36	15.83	.73	7.19
	.9	16.17	16.80	16.32	15.87	.81	4.46
	.8	16.27	16.59	16.27	15.91	.91	2.23**
	.7	16.41	16.33	16.21	15.98	1.04	1.24**
	.6	16.59	15.98	16.12	16.06	1.22	3.05**
6	1.0	18.31	18.92	18.94	18.00	.70	5.54
	.9	18.35	18.79	18.94	18.11	.78	3.55**
	.8	18.41	18.61	18.95	18.23	.88	2.00**
	.7	18.48	18.39	18.96	18.40	1.00	1.46**
	.6	18.57	18.10	18.97	18.62	1.17	3.13**

*This comparison group comprises non-CE students who were judged to be in need of reading (math) CE and attended non-CE schools with high concentrations of reading (math) low-achieving students and free-meal participants.

**Adjusted group means do not differ significantly among the groups at .01 level.

Table B3-17

Mean Student Affect Scores and Within-Group Regressions of Posttest on Pretest by Reading and Math CE Status

Grade		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students In Other-CE Schools	Non-CE Students in Title I Schools*	Non-CE Students in Other-CE Schools*	Students in Non-CE Schools*
				Reading CE Status			
Grade 2	N	2,748	869	651	1,615	770	508
Fall (Pretest)	Mean	83.86	79.54	80.50	82.28	81.19	81.95
Spring (Posttest)	Mean	85.78	84.17	81.82	84.39	82.30	85.97
Within-Group Slope**		.41	.44	.40	.46	.42	.47
Grade 3	N	2,784	826	593	1,650	785	551
Fall(Pretest)	Mean	84.67	84.37	81.94	81.98	78.92	80.93
Spring (Posttest)	Mean	84.36	83.73	81.85	81.37	78.95	81.02
Within-Group Slope**		.48	.47	.40	.53	.46	.47
Grade 4	N	2,206	828	586	1,787	900	534
Fall (Pretest)	Mean	80.54	80.36	78.37	78.88	76.94	79.55
Spring (Posttest)	Mean	80.85	80.01	78.69	79.30	77.38	80.30
Within-Group Slope**		.53	.59	.53	.58	.53	.58
Grade 5	N	2,097	753	555	1,921	1,014	622
Fall (Pretest)	Mean	81.26	79.62	77.20	77.67	75.62	79.14
Spring (Posttest)	Mean	80.55	77.96	78.16	76.33	74.55	77.31
Within-Group Slope**		.56	.58	.50	.63	.60	.63
Grade 6	N	1,867	847	584	1,909	1,647	723
Fall (Pretest)	Mean	79.99	77.42	74.96	74.62	72.81	77.87
Spring (Posttest)	Mean	79.54	75.95	73.81	72.73	70.06	75.17
Within-Group Slope**		.65	.68	.66	.66	.64	.69
				Math CE Status			
Grade 2	N	1,500	725	279	2,050	871	502
Fall (Pretest)	Mean	85.99	80.90	80.25	81.67	81.69	81.63
Spring (Posttest)	Mean	87.42	83.62	84.45	83.79	81.81	84.02
Within-Group Slope**		.40	.41	.42	.42	.41	.33
Grade 3	N	1,651	679	353	1,987	874	553
Fall (Pretest)	Mean	86.68	82.69	82.97	82.22	78.61	82.33
Spring (Posttest)	Mean	86.58	83.29	82.07	81.94	79.02	81.10
Within-Group Slope**		.48	.47	.47	.51	.49	.50
Grade 4	N	1,324	799	353	2,082	932	548
Fall (Pretest)	Mean	81.63	79.65	77.96	79.12	77.05	78.56
Spring (Posttest)	Mean	81.55	79.27	78.54	79.79	77.73	78.92
Within-Group Slope**		.54	.55	.51	.53	.52	.60
Grade 5	N	1,268	704	375	2,154	1,079	614
Fall (Pretest)	Mean	81.94	78.77	78.35	78.88	75.33	79.16
Spring (Posttest)	Mean	81.21	78.66	78.35	77.74	75.96	77.62
Within-Group Slope**		.56	.53	.54	.63	.58	.59
Grade 6	N	1,057	807	432	2,187	1,662	724
Fall (Pretest)	Mean	79.82	76.83	74.80	75.06	73.56	78.07
Spring (Posttest)	Mean	80.89	74.56	75.56	72.73	71.33	74.90
Within-Group Slope**		.67	.67	.65	.63	.61	.70

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*A random sample was selected from all non-CE students to supply the data for these groups.

**Slopes do not differ significantly among the six groups at .01 level.

Table B3-18

ANCOVA of Student Affect Scores for the Six Reading (Math)
CE Groups with Unreliability Corrections for the Pretest Scores

GRADE	Reliability Estimate	CE Status						Common Regression Coefficient	F
		Title I Students in Title I Schools	Title I Students in Title I Schools	CE Students In Other-CE Schools	Non-CE Students in Title I Schools*	Non-CE Students in Other-CE Schools*	Students in Non-CE Schools*		
Adjusted Group Means - Reading CE Status									
2	1.0	85.10	85.33	82.57	84.37	82.75	86.10	.43	5.28
	.9	85.02	85.46	82.65	84.37	82.80	86.12	.48	5.05
	.8	84.92	85.62	82.76	84.37	82.87	86.14	.53	4.82
	.7	84.80	85.83	82.89	84.37	82.95	86.16	.61	4.64
	.6	84.64	86.10	83.07	84.36	83.06	86.19	.71	4.61
3	1.0	83.50	83.02	82.31	81.80	80.85	81.95	.48	4.45
	.9	83.40	82.94	82.36	81.85	81.07	82.06	.53	3.54
	.8	83.28	82.84	82.42	81.91	81.33	82.19	.60	2.54**
	.7	83.13	82.71	82.50	81.98	81.67	82.36	.69	1.53**
	.6	82.92	82.54	82.61	82.09	82.12	82.58	.80	.64**
4	1.0	80.19	79.45	79.23	79.56	78.70	80.19	.55	1.41**
	.9	80.12	79.39	79.29	79.58	78.85	80.18	.61	1.08**
	.8	80.03	79.31	79.36	79.62	79.04	80.16	.69	.75**
	.7	79.91	79.21	79.46	79.67	79.27	80.14	.79	.47**
	.6	79.75	79.08	79.58	79.73	79.59	80.12	.92	.34**
5	1.0	79.08	77.45	79.08	76.97	76.40	77.09	.59	6.74
	.9	78.91	77.40	79.18	77.04	76.60	77.06	.65	5.59
	.8	78.71	77.33	79.31	77.13	76.86	77.03	.74	4.42
	.7	78.45	77.24	79.47	77.25	77.19	76.99	.84	3.38
	.6	78.09	77.11	79.69	77.40	77.63	76.94	.98	2.79**
6	1.0	77.04	75.15	74.63	73.77	72.29	74.07	.66	18.15
	.9	76.77	75.06	74.72	73.89	72.54	73.94	.73	14.35
	.8	76.42	74.95	74.83	74.03	72.85	73.79	.82	10.32
	.7	75.98	74.81	74.98	74.22	73.25	73.59	.94	6.31
	.6	75.38	74.62	75.17	74.47	73.78	73.33	1.10	2.99**
Adjusted Group Means - Math CE Status									
2	1.0	86.05	84.31	85.40	84.17	82.18	84.41	.40	5.92
	.9	85.90	84.39	85.51	84.21	82.22	84.45	.45	5.34
	.8	85.71	84.48	85.64	84.26	82.27	84.51	.50	4.71
	.7	85.47	84.60	85.81	84.33	82.34	84.58	.58	4.05
	.6	85.14	84.77	86.04	84.42	82.43	84.67	.67	3.43
3	1.0	84.79	83.45	82.09	82.33	81.18	81.44	.49	8.04
	.9	84.59	83.47	82.09	82.38	81.42	81.48	.54	6.53
	.8	84.34	83.49	82.09	82.43	81.72	81.53	.61	4.91
	.7	84.02	83.52	82.10	82.50	82.11	81.59	.70	3.25**
	.6	83.59	83.56	82.10	82.59	82.62	81.67	.82	1.79**
4	1.0	80.30	79.09	79.27	79.88	78.95	79.32	.54	1.17**
	.9	80.16	79.06	79.35	79.90	79.08	79.37	.60	.88**
	.8	79.98	79.04	79.45	79.91	79.25	79.42	.67	.61**
	.7	79.76	79.00	79.58	79.93	79.47	79.50	.77	.44**
	.6	79.46	78.96	79.75	79.95	79.76	79.59	.90	.50**
5	1.0	79.42	78.72	78.66	77.74	78.03	77.45	.59	2.51**
	.9	79.22	78.72	78.69	77.74	78.26	77.44	.65	2.04**
	.8	78.97	78.73	78.73	77.73	78.55	77.41	.73	1.71**
	.7	78.65	78.74	78.79	77.73	78.92	77.38	.84	1.71**
	.6	78.22	78.76	78.86	77.73	79.41	77.34	.98	2.42**
6	1.0	78.38	73.98	76.30	73.30	72.87	73.52	.65	21.43
	.9	78.10	73.92	76.38	73.36	73.04	73.37	.72	18.89
	.8	77.76	73.84	76.48	73.44	73.25	73.18	.81	16.13
	.7	77.31	73.73	76.61	73.54	73.53	72.93	.92	13.22
	.6	76.71	73.60	76.79	73.67	73.90	72.60	1.08	10.47

[*] A random sample was selected from all non-CE students to supply the data for these groups.

[**] Adjusted group means do not differ significantly among the six groups at .01 level.

Table B3-19

Mean Student Affect Scores and Within-Group Regressions of Posttest on Pretest Scores for Three Groups of CE Students and Two Comparison Groups of Needy Non-CE Students

Grade		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students In Other-CE Schools	Needy Non-CE Students in CE Schools	Needy Non-CE Students in Non-CE Schools
			Reading CE Status			
Grade 2	N	2,748	869	651	1,423	578
Fall (Pretest)	Mean	83.86	79.54	80.50	84.46	83.11
Spring (Posttest)	Mean	85.78	84.17	81.82	85.44	86.00
Within-Group Slope*		.41	.44	.40	.39	.35
Grade 3	N	2,784	826	593	1,369	547
Fall (Pretest)	Mean	84.67	84.37	81.94	83.14	83.65
Spring (Posttest)	Mean	84.36	83.73	81.85	83.44	82.29
Within-Group Slope*		.48	.47	.40	.47	.45
Grade 4	N	2,206	828	586	1,644	566
Fall (Pretest)	Mean	80.54	80.36	78.37	78.90	79.87
Spring (Posttest)	Mean	80.85	80.01	78.69	79.60	81.43
Within-Group Slope*		.53	.59	.53	.52	.55
Grade 5	N	2,097	753	555	1,785	501
Fall (Pretest)	Mean	81.26	79.62	77.20	79.77	82.06
Spring (Posttest)	Mean	80.55	77.96	78.16	79.01	80.25
Within-Group Slope*		.56	.58	.50	.60	.56
Grade 6	N	1,867	847	584	2,022	628
Fall (Pretest)	Mean	79.99	77.42	74.96	73.89	76.95
Spring (Posttest)	Mean	79.54	75.95	73.81	72.34	74.86
Within-Group Slope*		.65	.68	.66	.62	.70
			Math CE Status			
Grade 2	N	1,500	725	279	1,233	897
Fall (Pretest)	Mean	85.99	80.90	80.25	83.98	82.18
Spring (Posttest)	Mean	87.42	83.62	84.45	86.08	85.01
Within-Group Slope*		.40	.41	.42	.38	.33
Grade 3	N	1,651	679	353	1,289	993
Fall (Pretest)	Mean	86.68	82.69	82.97	84.00	81.93
Spring (Posttest)	Mean	86.58	83.29	82.07	83.62	82.36
Within-Group Slope*		.48	.47	.47	.48	.43
Grade 4	N.	1,324	799	353	1,370	1,095
Fall (Pretest)	Mean	81.63	79.65	77.96	78.79	78.76
Spring (Posttest)	Mean	81.55	79.27	78.54	79.83	79.69
Within-Group Slope*		.54	.55	.51	.57	.54
Grade 5	N	1,268	704	375	1,481	1,201
Fall (Pretest)	Mean	81.94	78.77	78.35	80.49	79.05
Spring (Posttest)	Mean	81.21	78.66	78.35	79.55	77.88
Within-Group Slope*		.56	.53	.54	.61	.57
Grade 6	N	1,057	807	432	1,677	1,249
Fall (Pretest)	Mean	79.82	76.83	74.80	75.82	75.18
Spring (Posttest)	Mean	80.89	74.56	75.56	74.47	73.55
Within-Group Slope*		.67	.67	.65	.65	.66

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*Slopes do not differ significantly among the five groups at .01 level.

Table B3-20

ANCOVA of Student Affect Scores for the Three Groups of CE Students and Two Comparison Groups of Needy Non-CE Students with Unreliability Corrections for the Pretest Scores

Grade	Reliability Estimate	CE Status					Common Regression Coefficient	F
		Title I Students in Title I Schools	Other-CE Students in Title I Schools	CE Students In Other-CE Schools	Needy Non-CE Students in CE Schools	Needy Non-CE Students in Non-CE Schools		
		Adjusted Group Means - Reading CE Status						
2	1.0	85.43	85.56	82.82	84.85	85.95	.40	3.61
	.9	85.39	85.71	82.93	84.78	85.94	.45	3.45
	.8	85.34	85.90	83.07	84.70	85.93	.50	3.34
	.7	85.28	86.15	83.25	84.59	85.93	.58	3.34
	.6	85.19	86.48	83.49	84.45	85.91	.67	3.60
3	1.0	84.01	83.53	82.78	83.81	82.42	.47	1.52*
	.9	83.98	83.51	82.88	83.85	82.44	.52	1.38*
	.8	83.93	83.48	83.01	83.90	82.46	.58	1.22*
	.7	83.87	83.44	83.18	83.97	82.48	.66	1.07*
	.6	83.79	83.39	83.40	84.06	82.51	.78	.97*
4	1.0	80.43	79.69	79.44	80.07	81.38	.54	1.44*
	.9	80.39	79.65	79.52	80.12	81.38	.60	1.34*
	.8	80.33	79.61	79.63	80.18	81.37	.67	1.25*
	.7	80.26	79.55	79.76	80.26	81.36	.77	1.19*
	.6	80.16	79.48	79.94	80.38	81.35	.89	1.22*
5	1.0	79.98	78.32	79.90	79.29	79.21	.57	1.85*
	.9	79.91	78.36	80.09	79.32	79.10	.63	1.78*
	.8	79.83	78.41	80.33	79.36	78.95	.71	1.81*
	.7	79.73	78.48	80.64	79.40	78.77	.81	2.03*
	.6	79.59	78.56	81.06	79.47	78.52	.95	2.66*
6	1.0	77.42	75.51	74.97	74.20	74.72	.65	10.99
	.9	77.18	75.46	75.10	74.41	74.70	.73	8.29
	.8	76.88	75.40	75.26	74.67	74.68	.82	5.50
	.7	76.50	75.32	75.47	75.00	74.65	.93	2.89*
	.6	76.00	75.21	75.75	75.44	74.62	1.09	1.08*
		Adjusted Group Means - Math CE Status						
2	1.0	86.49	84.65	85.73	85.92	85.54	.38	1.52*
	.9	86.39	84.76	85.87	85.91	85.60	.43	1.17*
	.8	86.26	84.90	86.05	85.88	85.67	.48	.81*
	.7	86.10	85.09	86.28	85.86	85.77	.55	.49*
	.6	85.88	85.33	86.58	85.82	85.90	.64	.30*
3	1.0	85.43	84.01	82.65	83.72	83.43	.47	3.93
	.9	85.31	84.09	82.72	83.73	83.55	.52	3.23*
	.8	85.15	84.19	82.80	83.75	83.70	.58	2.47*
	.7	84.94	84.32	82.91	83.77	83.89	.67	1.70*
	.6	84.67	84.49	83.05	83.79	84.15	.78	1.02*
4	1.0	80.45	79.26	79.46	80.29	80.16	.55	.88*
	.9	80.33	79.26	79.56	80.34	80.21	.61	. .79*
	.8	80.18	79.26	79.68	80.40	80.28	.68	.76*
	.7	79.98	79.25	79.85	80.49	80.36	.78	.84*
	.6	79.72	79.25	80.06	80.59	80.48	.91	1.18*
5	1.0	80.17	79.42	79.36	79.34	78.48	.57	1.89*
	.9	80.06	79.50	79.47	79.31	78.55	.63	1.53*
	.8	79.91	79.61	79.61	79.28	78.63	.71	1.18*
	.7	79.73	79.74	79.78	79.24	78.74	.81	.88*
	.6	79.48	79.93	80.02	79.19	78.88	.95	.78*
6	1.0	78.73	74.37	76.72	74.95	74.45	.66	15.10
	.9	78.49	74.35	76.85	75.00	74.55	.74	13.26
	.8	78.19	74.32	77.01	75.07	74.68	.83	11.23
	.7	77.80	74.29	77.21	75.16	74.84	.95	9.04
	.6	77.28	74.24	77.49	75.27	75.05	1.10	6.86

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*Adjusted group means do not differ significantly among the five groups at .01 level.

Table B3-21

Mean Student Affect Scores and Within-Group Regressions of Posttest on Pretest Scores For the CE Students and Two Comparison Groups of Needy Non-CE Students

Grade		CE Students	Needy Non-CE Students in CE Schools	Needy Non-CE Students on Non-CE Schools
		Reading CE Status		
Grade 2	N	4,268	1,423	578
Fall (Pretest)	Mean	82.46	84.46	83.11
Spring (Posttest)	Mean	84.84	85.44	86.00
Within-Group Slope*		.42	.39	.35
Grade 3	N	4,203	1,369	547
Fall (Pretest)	Mean	84.22	83.14	83.65
Spring (Posttest)	Mean	83.87	83.44	82.29
Within-Group Slope*		.47	.47	.45
Grade 4	N	3,620	1,644	566
Fall (Pretest)	Mean	80.14	78.90	79.87
Spring (Posttest)	Mean	80.30	79.60	81.43
Within-Group Slope*		.54	.52	.55
Grade 5	N	3,405	1,785	501
Fall (Pretest)	Mean	80.23	79.77	82.06
Spring (Posttest)	Mean	79.58	79.01	80.25
Within-Group Slope*		.56	.60	.56
Grade 6	N	3,298	2,022	628
Fall (Pretest)	Mean	78.43	73.89	76.95
Spring (Posttest)	Mean	77.60	72.34	74.86
Within-Group Slope*		.67	.62	.70
		Math CE Status		
Grade 2	N	2,504	1,233	897
Fall (Pretest)	Mean	83.87	83.98	82.18
Spring (Posttest)	Mean	85.98	86.08	85.01
Within-Group Slope*		.41	.38	.33
Grade 3	N	2,683	1,289	993
Fall (Pretest)	Mean	85.18	84.00	81.93
Spring (Posttest)	Mean	85.15	83.62	82.36
Within-Group Slope*		.48	.48	.43
Grade 4	N	2,476	1,370	1,095
Fall (Pretest)	Mean	80.46	78.79	78.76
Spring (Posttest)	Mean	80.38	79.83	79.69
Within-Group Slope*		.54	.57	.54
Grade 5	N	2,347	1,481	1,201
Fall (Pretest)	Mean	80.41	80.49	79.05
Spring (Posttest)	Mean	79.98	79.55	77.88
Within-Group Slope*		.55	.61	.57
Grade 6	N	2,296	1,677	1,249
Fall (Pretest)	Mean	77.82	75.82	75.18
Spring (Posttest)	Mean	77.66	74.47	73.55
Within-Group Slope*		.68	.65	.66

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*Slopes do not differ significantly among the three groups at .01 level.

Table B3-22

ANCOVA of Student Affect Scores for the CE Students and Two Comparison Groups of Needy Non-CE Students with Unreliability Corrections for the Pretest Scores

GRADE	Reliability Estimate	CE Status: CE Students	CE Status: Needy Non-CE Students in CE Schools	CE Status: Needy Non-CE Students in Non-CE Schools	Common Regression Coefficient	F
		Adjusted Group Means - Reading CE Status				
2	1.0	85.05	84.84	85.95	.40	.85*
	.9	85.07	84.78	85.94	.45	.92*
	.8	85.10	84.69	85.93	.51	1.05*
	.7	85.14	84.59	85.92	.58	1.27*
	.6	85.19	84.44	85.91	.67	1.69*
3	1.0	83.74	83.81	82.42	.47	1.61*
	.9	83.72	83.85	82.44	.52	1.60*
	.8	83.70	83.90	82.46	.58	1.59*
	.7	83.68	83.97	82.48	.66	1.61*
	.6	83.65	84.05	82.51	.78	1.69*
4	1.0	80.10	80.06	81.38	.54	1.65*
	.9	80.07	80.12	81.37	.60	1.62*
	.8	80.05	80.18	81.37	.67	1.64*
	.7	80.01	80.26	81.36	.77	1.71*
	.6	79.96	80.37	81.34	.90	1.91*
5	1.0	79.59	79.29	79.21	.57	.31*
	.9	79.59	79.32	79.09	.63	.36*
	.8	79.60	79.35	78.95	.71	.46*
	.7	79.60	79.40	78.77	.82	.67*
	.6	79.60	79.47	78.52	.95	1.09*
6	1.0	76.48	74.21	74.71	.66	14.19
	.9	76.36	74.41	74.70	.73	10.64
	.8	76.20	74.67	74.68	.82	7.00
	.7	76.00	75.01	74.65	.94	3.62*
	.6	75.74	75.45	74.61	1.09	1.40*
		Adjusted Group Means - Math CE Status				
2	1.0	85.87	85.92	85.54	.39	.15*
	.9	85.86	85.90	85.60	.43	.10*
	.8	85.84	85.88	85.68	.48	.04*
	.7	85.82	85.85	85.77	.55	.01*
	.6	85.79	85.82	85.90	.64	.01*
3	1.0	84.70	83.72	83.44	.47	2.87*
	.9	84.65	83.73	83.56	.52	2.31*
	.8	84.59	83.75	83.71	.59	1.70*
	.7	84.51	83.77	83.90	.67	1.10*
	.6	84.40	83.79	84.16	.78	.61*
4	1.0	79.92	80.29	80.16	.55	.24*
	.9	79.87	80.34	80.21	.61	.41*
	.8	79.81	80.40	80.28	.69	.70*
	.7	79.72	80.48	80.36	.78	1.18*
	.6	79.61	80.59	80.48	.91	2.01*
5	1.0	79.81	79.33	78.48	.57	3.02*
	.9	79.79	79.31	78.55	.63	2.66*
	.8	79.77	79.28	78.63	.71	2.34*
	.7	79.74	79.24	78.74	.81	1.76*
	.6	79.70	79.19	78.88	.95	1.25*
6	1.0	76.81	74.95	74.45	.67	11.87
	.9	76.72	75.01	74.56	.74	10.01
	.8	76.60	75.07	74.68	.83	7.90
	.7	76.45	75.16	74.84	.95	5.56
	.6	76.25	75.28	75.06	1.11	3.07*

*Adjusted group means do not differ significantly among the three groups at .01 level.

Table B3-23

Mean Student Affect Scores and Within-Group Regressions of Posttest on Pretest Scores for the Three Groups of CE Students and a Comparison Group of Needy Non-CE Students

Grade		Title I Students in Title I Schools	Other-CE Students in Other-CE Schools	CE Students in Other-CE Schools	Comparison Group
			Reading CE Status		
Grade 2	N	2,748	869	651	371
Fall (Pretest)	Mean	83.86	79.54	80.50	85.65
Spring (Posttest)	Mean	85.78	84.17	81.82	87.70
Within-Group Slope**		.41	.44	.40	.33
Grade 3	N	2,784	826	593	368
Fall (Pretest)	Mean	84.67	84.37	81.94	86.87
Spring (Posttest)	Mean	84.36	83.73	81.85	84.00
Within-Group Slope**		.48	.47	.40	.47
Grade 4	N	2,206	828	586	338
Fall (Pretest)	Mean	80.54	80.36	78.37	82.88
Spring (Posttest)	Mean	80.85	80.01	78.69	84.25
Within-Group Slope**		.53	.59	.53	.55
Grade 5	N	2,097	753	555	341
Fall (Pretest)	Mean	81.26	79.62	77.20	87.56
Spring (Posttest)	Mean	80.55	77.96	78.16	84.53
Within-Group Slope**		.56	.58	.50	.53
Grade 6	N	1,867	847	584	333
Fall (Pretest)	Mean	79.99	77.42	74.96	81.89
Spring (Posttest)	Mean	79.54	75.95	73.81	79.82
Within-Group Slope**		.65	.68	.66	.68
			Math CE Status		
Grade 2	N	1,500	725	279	499
Fall (Pretest)	Mean	85.99	80.90	80.25	85.30
Spring (Posttest)	Mean	87.42	83.62	84.45	87.38
Within-Group Slope**		.40	.41	.42	.33
Grade 3	N	1,651	679	353	549
Fall (Pretest)	Mean	86.68	82.69	82.97	86.42
Spring (Posttest)	Mean	86.58	83.29	82.07	85.78
Within-Group Slope**		.48	.47	.47	.46
Grade 4	N	1,324	799	353	614
Fall (Pretest)	Mean	81.63	79.65	77.96	81.67
Spring (Posttest)	Mean	81.55	79.27	78.54	82.65
Within-Group Slope**		.54	.55	.51	.52
Grade 5	N	1,268	704	375	683
Fall (Pretest)	Mean	81.94	78.77	78.35	83.08
Spring (Posttest)	Mean	81.21	78.66	78.35	81.78
Within-Group Slope**		.56	.53	.54	.53
Grade 6	N	1,057	[illegible]07	432	601
Fall (Pretest)	Mean	79.82	76.83	74.80	79.76
Spring (Posttest)	Mean	80.89	74.56	75.56	78.34
Within-Group Slope**		.67	.67	.65	.65

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[*] This comparison group comprises non-CE students who were judged to be in need of reading (math) CE and attended non-CE schools with high concentrations of reading (math) low-achieving students and free-meal participants.

[**] Slopes do not differ significantly among the groups at .01 level.

Table B3-24

ANCOVA of Student Affect Scores for the Three Groups of CE Students and Two Comparison Groups of Needy Non-CE Students with Unreliability Corrections for Pretest Scores

GRADE	Reliability Estimate	CE Status				Common Regression Coefficient	F
		Title I Students in Title I Schools	Other-CE Students in Other-CE Schools	CE Students in Other-CE Schools	Comparison Groups*		
		Adjusted Group Means - Reading CE Status					
2	1.0	85.32	85.47	82.73	86.50	.41	5.14
	.9	85.27	85.62	82.83	86.37	.45	4.73
	.8	85.20	85.80	82.96	86.20	.51	4.32
	.7	85.12	86.03	83.12	85.99	.58	4.00
	.6	85.01	86.34	83.33	85.70	.68	3.91
3	1.0	84.25	83.77	83.02	82.87	.47	1.49**
	.9	84.24	83.77	83.15	82.74	.52	1.45**
	.8	84.22	83.77	83.32	82.58	.58	1.43**
	.7	84.20	83.78	83.52	82.38	.67	1.50**
	.6	84.18	83.79	83.80	82.11	.78	1.75**
4	1.0	80.76	80.02	79.78	82.89	.54	3.30**
	.9	80.75	80.02	79.90	82.74	.60	2.85**
	.8	80.74	80.02	80.05	82.55	.68	2.35**
	.7	80.73	80.02	80.25	82.31	.77	1.80**
	.6	80.70	80.03	80.50	81.99	.90	1.25**
5	1.0	80.35	78.67	80.21	80.83	.56	2.67**
	.9	80.33	78.75	80.44	80.42	.62	2.27**
	.8	80.31	78.85	80.73	79.91	.69	2.15**
	.7	80.27	78.98	81.10	79.25	.79	2.59**
	.6	80.22	79.15	81.58	78.37	.93	4.18
6	1.0	78.72	76.84	76.33	77.73	.66	5.29
	.9	78.63	76.94	76.61	77.50	.74	4.05
	.8	78.52	77.06	76.96	77.21	.83	2.84**
	.7	78.37	77.22	77.41	76.84	.95	1.89**
	.6	78.18	77.43	78.01	76.35	1.10	1.63**
		Adjusted Group Means - Math CE Status					
2	1.0	86.69	84.88	85.96	86.92	.39	2.20**
	.9	86.60	85.02	86.13	86.87	.43	1.72**
	.8	86.50	85.19	86.34	86.80	.49	1.23**
	.7	86.37	85.42	86.61	86.72	.56	.78**
	.6	86.20	85.72	86.97	86.61	.65	.49**
3	1.0	85.97	84.57	83.21	85.30	.47	3.45**
	.9	85.91	84.71	83.34	85.25	.52	2.87**
	.8	85.82	84.89	83.50	85.18	.59	2.23**
	.7	85.71	85.12	83.70	85.10	.67	1.60**
	.6	85.57	85.42	83.97	84.98	.79	1.05**
4	1.0	81.06	79.84	80.02	82.13	.54	2.66**
	.9	81.00	79.91	80.19	82.08	.60	2.28**
	.8	80.93	79.98	80.39	82.01	.67	1.88**
	.7	80 84	80.09	80.66	81.91	.77	1.47**
	.6	80.72	80.22	81.01	81.79	.90	1.11**
5	1.0	80.71	79.87	79.80	80.66	.54	.72**
	.9	80.66	80.01	79.96	80.54	.60	.40**
	.8	80.59	80.18	80.16	80.38	.68	.15**
	.7	80.50	80.39	80.41	80.18	.77	.06**
	.6	80.38	80.68	80.76	79.92	.90	.37**
6	1.0	79.84	75.49	77.84	77.32	.66	13.21
	.9	79.72	75.59	78.09	77.21	.74	12.08
	.8	79.57	75.72	78.40	77.07	.83	10.91
	.7	79.38	75.88	78.81	76.89	.95	9.82
	.6	79.13	76.10	79.35	76.64	1.11	9.06

[*] This comparison group comprises non-CE students who were judged to be in need of reading (math) CE and attended non-CE schools with high concentrations of reading (math) low-achieving students and free-meal participants.

[**] Adjusted group means do not differ significantly among the groups at .01 level.

APPENDIX B4

SUPPLEMENTARY TABLES FOR COMPARISONS OF GAINS CONDITIONAL ON PRETEST SCORES

Table B4-1

'Cut-Off' Pretest Scores Used in the Comparisons of Predicted Posttest Scores Between CE and Non-CE Students*

Grade	Approximate Percentile	Reading Achievement		Math Achievement		Practical Achievement Scale
		VSS	(Raw Score)	VSS	(Raw Score)	Raw Score
1	30	326	(10)	314	(12)	NA
	35	333	(11)	320	(13)	
	40	339	(12)	326	(14)	
	45	345	(13)	331	(15)	
2	30	391	(18)	375	(14)	NA
	35	396	(19)	382	(15)	
	40	405	(21)	388	(16)	
	45	412	(23)	394	(17)	
3	30	427	(25)	418	(25)	NA
	35	436	(27)	427	(27)	
	40	444	(29)	435	(29)	
	45	456	(32)	442	(31)	
4	30	462	(26)	460	(23)	9
	35	468	(27)	467	(24)	10
	40	478	(29)	480	(26)	11
	45	487	(31)	487	(27)	12
5	30	496	(33)	511	(31)	13
	35	508	(36)	522	(33)	15
	40	518	(39)	532	(35)	16
	45	527	(42)	542	(37)	17
6	30	519	(27)	536	(21)	17
	35	531	(29)	545	(22)	18
	40	541	(31)	554	(23)	20
	45	551	(33)	562	(24)	21

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*The 'cut-off' pretest scores are selected to be as close as possible to the scores for the 30th, 35th, 40th, and 45th percentiles according to the Fall norm. For reading and math, the at-level norms are used to select these cut-off scores for comparison.

Table B4-2

Comparisons of Predicted Reading Posttest Scores Between CE Students and Each of Four Comparison Groups of Non-CE Students at Four 'Cutoff' Pretest Scores that Correspond to the 30th, 35th, 40th, and 45th Percentile Ranks of the National Norms (Linear and Quadratic Within-Group Regression Models of Posttest Score on Pretest Score Are Employed for the Prediction)*

GRADE	CE Students and Comparison Groups*	N	30th Percentile 'Cutoff'				35th Percentile 'Cutoff'				40th Percentile 'Cutoff'				45th Percentile 'Cutoff'			
			Linear		Quadratic		Linear		Quadratic		Linear		Quadratic		Linear		Quadratic	
			$\hat{Y}\|X$*	t_{diff}**	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}
1	CE Students	4,346	385		383		391		389		396		394		400		399	
	Non-CE/CE	10,352	396	-15.52	395	-14.74	402	-17.00	401	-15.26	407	-17.70	406	-15.57	413	-17.82	412	-15.76
	Non-CE/Non-CE	2,177	395	-9.82	396	-10.71	401	-10.46	402	-11.02	406	-10.69	407	-11.09	411	-10.57	412	-10.99
	Needy Non-CE/CE	1,999	380	5.64	379	3.88	384	6.74	384	4.85	388	7.35	387	5.68	392	7.68	391	6.43
	Needy Non-CE/Non-CE	541	377	4.90	380	1.67	382	5.44	384	2.38	385	5.69	388	3.15	389	5.79	391	4.00
2	CE Students	4,688	433		429		437		433		443		440		449		446	
	Non-CE/CE	8,847	440	-11.76	440	-15.84	445	-12.72	445	-16.55	452	-14.13	452	-17.27	458	-14.87	458	-17.31
	Non-CE/Non-CE	1,976	438	-4.93	435	-5.68	442	-5.33	439	-5.74	449	-5.91	446	-5.70	454	-6.23	452	-5.54
	Needy Non-CE/CE	1,572	428	4.43	425	3.41	432	4.45	429	3.35	438	4.34	436	3.16	443	4.18	442	2.94
	Needy Non-CE/Non-CE	678	424	6.21	421	4.91	427	6.51	425	5.18	432	6.82	431	5.50	436	6.91	436	5.58
3	CE Students	4,535	460		458		467		465		473		471		482		481	
	Non-CE/CE	8,881	467	-10.24	467	-12.98	475	-11.99	475	-14.28	482	-13.31	481	-15.08	492	-14.70	492	-15.62
	Non-CE/Non-CE	1,961	465	-5.33	465	-6.72	473	-6.46	472	-7.31	480	-7.39	479	-7.66	490	-8.51	489	-7.92
	Needy Non-CE/CE	1,473	460	0.17	458	-0.38	467	0.27	465	-0.46	473	0.34	471	-0.54	482	0.42	481	-0.66
	Needy Non-CE/Non-CE	591	453	5.25	454	2.27	458	5.74	459	3.02	463	5.96	464	3.75	471	6.06	471	4.83
4	CE Students	3,875	489		483		494		488		502		497		509		505	
	Non-CE/CE	9,599	497	-11.32	497	-17.90	502	-12.10	502	-18.10	511	-13.10	510	-17.83	519	-13.65	518	-16.94
	Non-CE/Non-CE	1,980	497	-6.93	495	-9.99	502	-7.56	500	-10.02	511	-8.46	508	-9.79	519	-9.08	516	-9.29
	Needy Non-CE/CE	1,729	489	-0.04	485	-1.13	494	0.23	489	-1.08	501	0.63	498	-0.99	508	0.92	506	-0.91
	Needy Non-CE/Non-CE	613	489	0.15	484	-0.20	494	0.05	489	-0.25	502	-0.09	497	-0.31	509	-0.19	505	-0.35
5	CE Students	3,616	518		514		528		525		537		534		544		543	
	Non-CE/CE	10,391	526	-11.60	526	-15.71	537	-12.76	537	-15.59	547	-13.34	546	-14.83	555	-13.62	554	-13.64
	Non-CE/Non-CE	2,227	526	-8.02	524	-9.68	537	-8.90	535	-9.35	546	-9.39	544	-8.76	555	-9.65	553	-7.99
	Needy Non-CE/CE	1,899	518	0.51	514	-0.01	527	0.75	525	0.10	536	0.91	534	0.15	543	1.01	543	0.16
	Needy Non-CE/Non-CE	548	513	2.71	511	1.61	523	2.54	522	1.36	531	2.38	532	1.12	539	2.26	541	0.91
6	CE Students	3,507	541		537		552		548		560		557		569		567	
	Non-CE/CE	12,658	548	-9.39	548	-14.52	559	-10.41	559	-14.88	568	-10.96	568	-14.55	577	-11.29	578	-13.64
	Non-CE/Non-CE	2,553	546	-5.35	546	-8.33	558	-6.44	557	-8.44	567	-7.18	566	-8.22	576	-7.75	575	-7.72
	Needy Non-CE/CE	2,124	541	0.23	539	-1.59	551	0.71	549	-0.85	559	1.04	557	-0.16	567	1.30	566	0.58
	Needy Non-CE/Non-CE	676	540	1.03	535	0.91	550	1.11	546	0.79	558	1.14	556	0.65	566	1.16	566	0.47

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* The predicted posttest scores ($\hat{Y}|X$) are obtained from the estimated within-group regressions of posttest scores (Y) on pretest scores (X). The four comparison groups of non-CE students are: Non-CE/CE = reading non-CE students in schools that provide CE in reading; Non-CE/Non-CE = reading non-CE students in schools that do not provide CE in reading; Needy Non-CE/CE = a subgroup of Non-CE/CE judged to be in need of reading CE; Needy Non-CE/Non-CE = a subgroup of Non-CE/Non-CE judged to be in need of reading CE.

** The critical value at the .01 level for the two-tailed t-tests of the differences in predicted posttest scores between CE students and the comparison group is 2.58, as the d.f. exceeds 500 in all cases. Negative t-values indicate that the predicted score for the CE students is lower than that for the comparison group.

Table B4-3

Comparisons of Predicted Math Posttest Scores Between CE Students and Each of Four Comparison Groups of Non-CE Students at Four 'Cutoff' Pretest Scores that Correspond to the 30th, 35th, 40th, and 45th Percentile Ranks of the National Norms (Linear and Quadratic Within-Group Regression Models of Posttest Score on Pretest Score Are Employed for the Prediction)*

GRADE	CE Students and Comparison Groups*	N	30th Percentile 'Cutoff'				35th Percentile 'Cutoff'				40th Percentile 'Cutoff'				45th Percentile 'Cutoff'			
			Linear		Quadratic		Linear		Quadratic		Linear		Quadratic		Linear		Quadratic	
			$\hat{Y}\|X$*	t_{diff}**	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}
1	CE Students	2,782	375		373		379		377		384		382		388		385	
	Non-CE/CE	8,951	380	-6.79	380	-7.81	385	-7.60	385	-8.28	390	-8.21	389	-8.62	394	-8.53	394	-8.81
	Non-CE/Non-CE	5,105	377	-2.64	376	-3.31	382	-3.34	381	-3.69	387	-3.96	386	-4.02	391	-4.38	390	-4.26
	Needy Non-CE/CE	1,599	364	9.23	362	7.64	368	9.42	366	7.78	372	9.34	371	7.79	375	9.14	374	7.64
	Needy Non-CE/Non-CE	1,051	360	11.40	359	9.37	364	11.77	362	9.80	367	11.81	366	10.10	370	11.66	369	10.21
2	CE Students	2,785	428		424		433		430		438		435		442		440	
	Non-CE/CE	7,966	437	-10.88	436	-12.24	443	-11.25	442	-12.33	447	-11.36	447	-12.25	452	-11.28	452	-12.02
	Non-CE/Non-CE	4,727	432	-4.85	432	-6.80	438	-5.04	437	-6.76	442	-5.10	442	-6.61	447	-5.08	446	-6.34
	Needy Non-CE/CE	1,353	421	4.92	419	3.82	426	4.97	424	3.81	430	4.94	429	3.75	435	4.85	434	3.64
	Needy Non-CE/Non-CE	1,035	417	7.48	417	4.67	422	7.46	421	4.97	426	7.33	425	5.24	430	7.14	429	5.50
3	CE Students	2,930	470		471		477		478		483		483		488		489	
	Non-CE/CE	7,799	482	-12.47	483	-11.81	489	-13.18	491	-12.88	495	-13.46	498	-13.52	501	-13.44	504	-13.94
	Non-CE/Non-CE	4,633	482	-11.61	483	-10.72	490	-12.92	491	-11.92	497	-13.75	498	-12.83	503	-14.18	504	-13.51
	Needy Non-CE/CE	1,370	464	4.82	465	3.90	470	4.82	471	4.15	476	4.70	476	4.34	481	4.55	481	4.45
	Needy Non-CE/Non-CE	1,057	463	4.96	466	2.77	468	5.48	471	3.72	473	5.75	475	4.60	477	5.87	478	5.34
4	CE Students	2,652	507		507		513		512		523		522		529		528	
	Non-CE/CE	7,954	518	-11.14	519	-10.97	524	-11.52	525	-11.43	535	-11.83	536	-12.00	541	-11.77	542	-12.15
	Non-CE/Non-CE	4,810	516	-7.86	516	-7.60	522	-8.47	522	-8.04	533	-9.30	533	-8.72	539	-9.56	539	-9.00
	Needy Non-CE/CE	1,455	506	1.23	504	1.29	511	1.42	510	1.39	521	1.67	520	1.50	526	1.76	525	1.50
	Needy Non-CE/Non-CE	1,169	504	2.14	504	1.42	509	2.18	509	1.50	519	2.17	519	1.66	525	2.13	525	1.73
5	CE Students	2,499	550		547		559		556		567		565		575		573	
	Non-CE/CE	8,330	560	-9.42	559	-9.86	570	-10.35	569	-10.37	579	-10.91	578	-10.67	588	-11.22	587	-10.75
	Non-CE/Non-CE	5,389	558	-6.60	555	-6.27	568	-7.45	565	-6.58	577	-8.01	574	-6.79	585	-8.38	583	-6.89
	Needy Non-CE/CE	1,606	545	3.89	542	3.18	553	4.05	551	3.06	560	4.10	560	2.83	567	4.09	569	2.47
	Needy Non-CE/Non-CE	1,270	542	5.40	541	3.18	550	5.11	550	3.31	558	4.79	558	3.40	566	4.46	566	3.42
6	CE Students	2,449	577		573		584		580		591		588		598		595	
	Non-CE/CE	10,410	580	-3.43	580	-5.77	588	-4.19	588	-6.28	597	-4.88	596	-6.67	604	-5.41	603	-6.91
	Non-CE/Non-CE	5,819	581	-3.43	580	-5.50	589	-4.37	589	-6.18	597	-5.25	597	-6.75	605	-5.94	604	-7.14
	Needy Non-CE/CE	1,767	570	4.76	567	3.74	577	5.09	574	3.99	584	5.30	581	4.20	590	5.39	588	4.33
	Needy Non-CE/Non-CE	1,321	567	6.13	565	4.45	574	6.19	572	4.58	581	6.12	579	4.68	587	5.99	586	4.72

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* The predicted posttest scores ($\hat{Y}|X$) are obtained from the estimated within-group regressions of posttest scores (Y) on pretest scores (X). The four comparison groups of non-CE students are: Non-CE/CE = math non-CE students in schools that provide CE in math; Non-CE/Non-CE = math non-CE students in schools that do not provide CE in math; Needy Non-CE/CE = a subgroup of Non-CE/CE judged to be in need of math CE; Needy Non-CE/Non-CE = a subgroup of Non-CE/Non-CE judged to be in need of math CE.

** The critical value at the .01 level for the two-tailed t-tests of the differences in predicted posttest scores between CE students and the comparison group is 2.58, as the d.f. exceeds 500 in all cases. Negative t-values indicate that the predicted score for the CE students is lower than that for the comparison group.

Table B4-4

Comparisons of Predicted Practical Achievement Posttest Scores Between CE Students and Each of Four Comparison Groups of Non-CE Students at Four 'Cutoff' Pretest Scores that Correspond to the 30th, 35th, 40th, and 45th Percentile Ranks of the National Norms (Linear and Quadratic Within-Group Regression Models of Posttest Score on Pretest Score Are Employed for the Prediction)*

GRADE	CE Students and Comparison Groups*	N	30th Percentile 'Cutoff'				35th Percentile 'Cutoff'				40th Percentile 'Cutoff'				45th Percentile 'Cutoff'			
			Linear		Quadratic		Linear		Quadratic		Linear		Quadratic		Linear		Quadratic	
			$\hat{Y}\|X$*	t_{diff}**	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}	$\hat{Y}\|X$	t_{diff}
4	CE Students	4,338	13.1		12.9		13.8		13.6		14.6		14.3		15.3		15.1	
	Non-CE/CE	9,097	15.0	-20.15	15.0	-20.57	15.7	-20.67	15.8	-21.32	16.5	-20.64	16.6	-21.33	17.2	-20.02	17.4	-20.89
	Non-CE/Non-CE	1,912	14.6	-10.58	14.6	-11.43	15.4	-11.15	15.4	-11.69	16.1	-11.51	16.2	-11.57	16.9	-11.61	16.9	-11.24
	Needy Non-CE/CE	1,784	13.4	-2.65	13.3	-2.58	14.2	-2.59	14.0	-2.43	14.9	-2.41	14.7	-2.26	15.7	-2.16	15.4	-2.11
	Needy Non-CE/Non-CE	634	13.3	-1.20	12.9	-0.27	13.9	-0.65	13.5	0.33	14.6	-0.09	14.1	0.81	15.3	0.41	14.8	1.17
5	CE Students	4,087	16.3		16.2		17.8		17.7		18.5		18.4		19.3		19.2	
	Non-CE/CE	9,830	17.9	-16.98	18.0	-16.32	19.3	-16.75	19.4	-15.99	20.0	-16.07	20.1	-15.62	20.7	-15.08	20.9	-15.14
	Non-CE/Non-CE	2,173	17.8	-10.09	17.6	-8.12	19.1	-9.92	18.9	-6.80	19.8	-9.53	19.5	-6.23	20.5	-8.94	20.2	-5.74
	Needy Non-CE/CE	1,953	16.6	-2.24	16.5	-1.70	18.1	-1.88	17.9	-1.44	18.8	-1.64	18.7	-1.34	19.5	-1.39	19.4	-1.25
	Needy Non-CE/Non-CE	617	16.1	0.86	16.1	0.37	17.6	0.89	17.6	0.41	18.3	0.86	18.3	0.45	19.1	0.83	19.0	0.50
6	CE Students	3,913	19.6		19.5		20.4		20.2		21.8		21.7		22.5		22.5	
	Non-CE/CE	12,156	20.9	-15.77	20.9	-14.45	21.6	-14.77	21.5	-13.68	22.8	-12.03	22.8	-11.62	23.5	-10.51	23.5	-10.18
	Non-CE/Non-CE	2,493	20.3	-5.43	20.5	-6.46	21.0	-5.40	21.2	-6.37	22.4	-5.00	22.6	-5.87	23.1	-4.66	23.3	-5.38
	Needy Non-CE/CE	2,328	20.0	-3.02	20.1	-3.77	20.7	-2.53	20.7	-3.34	22.0	-1.51	22.0	-2.16	22.7	-1.06	22.7	-1.40
	Needy Non-CE/Non-CE	704	19.7	-0.43	19.7	-1.06	20.5	-0.48	20.5	-1.06	21.9	-0.55	21.9	-0.88	22.6	-0.56	22.6	-0.70

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* The predicted posttest scores ($\hat{Y}|X$) are obtained from the estimated within-group regressions of posttest scores (Y) on pretest scores (X). The four comparison groups of non-CE students are: Non-CE/CE = reading and math non-CE students in schools that provide CE in reading and/or math; Non-CE/Non-CE = reading and math Non-CE students in schools that do not provide CE in reading and math; Needy Non-CE/CE = a subgroup of Non-CE/CE judged to be in need of reading and/or math CE; Needy Non-CE/Non-CE = a subgroups of Non-CE/Non-CE judged to be in need of reading and/or math CE.

** The critical value at the .01 level for the two-tailed t-tests of the differences in predicted posttest scores between CE students and the comparison group is 2.58 as the d.f. exceeds 500 in all cases. Negative t-values indicate that the predicted score for the CE students is lower than that for the comparison group.

APPENDIX B5

SUPPLEMENTARY TEXT AND TABLES

FOR COMPARISONS WITH EXPECTED GROWTH

Analysis for Reading and Math Achievement

This last approach for the evaluation of the effectiveness of CE employs statistical models to approximate the expected performance of CE students under the 'no-CE' situation. In essence, we consider the pretest score and student background characteristics as predictors in the estimation of the posttest performance for a hypothetical group of non-CE students whose background and pretest achievement level are comparable to those of the sample of CE students involved in the evaluation. The predicted mean posttest performance for this hypothetical group of non-CE students is then used as the expected mean performance for the CE students in order to judge the effectiveness of CE. If we are reasonably certain that the actual mean performance for the CE students exceeds this comparison standard, it may be concluded that CE is effective. Conversely, if there is little chance for the observed mean performance of the CE students to exceed the standard, CE is judged to be ineffective. Following a similar position taken in the norm-referenced analyses, we adopt a probability level of .9 to express certainty.

Regression Models for Estimating Expected Posttest Achievement. Two regression models were developed for the estimation of the expected posttest performance assuming no CE intervention: one obtained with data for non-CE students in CE schools, and one with data for non-CE students in non-CE schools. As mentioned in the general discussion in the text, we separated these two groups of students in the development of the prediction models because the CE and non-CE schools may differ in school characteristics, characteristics of regular educational programs, as well as characteristics of student composition; and because there may be spillover effects of CE in the CE schools. A 15 percent random sample was selected from each of these two groups of non-CE students in each grade to provide the data for the estimation of the regression equations.

The primary potential predictors included the pretest score, five student characteristics, and level of school's regular per-pupil expenditures. The five student characteristics employed were: white/minority status, participation in free-meal programs (as a proxy for family economic status), mother's educational attainment, receipt of CE in the previous year (1975-76), and teacher's judgment of need for CE. These characteristics were considered because they are likely to have influences on achievement growth, particularly through their relationships with the educational climate at home, and possible learning problems. The regular per-pupil expenditures were divided into ten levels corresponding to ten intervals of equal frequencies in the distribution over the first-year representative sample. The pretest score and teacher's judgment of need for CE were obtained for reading and math separately.

In addition, the squared pretest score was included in the pool of potential predictors because measurement errors of pretest scores may introduce nonlinearity to the regression model (Cochran, 1970). Considerations of possible differences in regression coefficients for the pretest score between groups of students with different characteristics led us to add also the products of the pretest score and the variable of each student characteristic to the predictor set. These product terms in effect represent the interactions between pretest achievement and student characteristics. When within-group regressions were different among groups of students with different characteristics, the appropriate interaction terms would be selected into the regression model. On the other hand, if homogeneity of regressions held, the interaction terms would be ignored in the prediction model. In total, 13 variables were involved as potential predictors.

A best subset of the 13 variables was obtained using the method of 'all possible subset regressions' (Hocking, 1976), and employed in the estimation of the prediction model for the present analyses. The primary criterion for the subset selection was Mallow's C_p. For each analysis, five best subsets of predictors were selected according to this criterion. Then the coefficient of determination (R^2), adjusted R^2, and the regression coefficients for each subset were examined in order to choose a satisfactory subset for the final prediction model. The regression models for prediction were developed for reading and math separately, and for each of the two subsamples of non-CE students in each grade. The potential predictors for the models are listed in Table B5-1, along with indications of whether they were selected into the prediction models.

To assess the validity of each prediction model, a second 15 percent random sample was independently selected from each group of non-CE students in each grade to serve as the cross-validation sample. Summary results of the cross-validation studies are presented in Table B5-2. On the basis of the summary statistics and the F-tests, and considering the large sample sizes, we judge the models to be quite adequate in most cases. Further information about the adequacy of the models is provided in Table B5-3, where possible biases of the prediction models against specific groups of students were examined. The data show that the models are generally appropriate for predicting the posttest performance of subgroups of students with different characteristics, as there is little evidence of biases. The reader is advised to study these data carefully, as the same models are also employed to compute residual gain scores that serve as measures of growth in the analyses of Chapters 4 and 5.

For convenience, we designate the prediction model developed from the data for non-CE students in non-CE schools as Regression Model A, and that from the data for non-CE students in CE schools as Regression Model B. The residual gain scores computed with these models are accordingly named Residual Gain Score A and Residual Gain Score B in later chapters.

Additional data that attest to the success of these models may be seen in Tables E-1 and E-2 of Appendix E. There it is shown that the models give very accurate predictions of the actual mean performances for the two special subgroups of non-CE students who are judged as needing CE. These two groups of 'needy' non-CE students comprise the principal comparison groups in many of our analyses. The implication of these results is that models developed from a random sample of non-CE students in general are not biased against groups of students whose pretest scores tend to be in the lower end of the distribution and who tend to have characteristics associated with educational deprivation.

Table B5-1

Predictor Variables Employed (✓ in Table Entries) in the Regression Equations for Estimating the Expected Posttest Scores of the CE Students

Sample Used to Estimate the Reg. Eq.	Potential Predictor Variables*	Variables Included in the Estimated Regression Equation for														
		READING						MATH						PAS		
		Grade						Grade						Grade		
		1	2	3	4	5	6	1	2	3	4	5	6	4	5	6
Non-CE Students in CE Schools	Pretest Score	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Caucasian-White/Minority (WM)		✓	✓	✓	✓	✓			✓	✓	✓		✓		✓
	Free-Meal Participation (FMP)	✓		✓		✓		✓		✓		✓	✓	✓	✓	
	CE Receipt in 75-76 (CE75)	✓	✓		✓		✓		✓				✓			✓
	Judged Need in CE (NEED)	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	Mother's Highest Education (MOED)	✓			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
	Regular Per-Pupil Expenditure (EXP)			✓		✓				✓		✓				
	Pretest Score Squared			✓	✓		✓	✓		✓	✓					
	Interaction - WM x Pretest										✓			✓		
	Interaction - FMP x Pretest						✓			✓		✓				
	Interaction - CE75 x Pretest		✓						✓				✓			✓
	Interaction - NEED x Pretest				✓	✓							✓	✓		
	Interaction - MOED x Pretest	✓			✓		✓	✓							✓	✓
Non-CE Students in Non-CE Schools	Pretest Score	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Caucasian-White/Minority (WM)	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓
	Free-Meal Participation (FMP)	✓				✓	✓	✓		✓		✓	✓			✓
	CE Receipt in 75-76 (CE75)					✓				✓				✓		✓
	Judged Need in CE (NEED)	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
	Mother's Highest Education (MOED)	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Regular Per-Pupil Expenditure (EXP)						✓	✓					✓			
	Pretest Score Squared			✓	✓	✓			✓			✓			✓	
	Interaction - WM x Pretest	✓									✓		✓		✓	✓
	Interaction - FMP x Pretest					✓				✓						
	Interaction - CE75 x Pretest													✓		✓
	Interaction - NEED x Pretest	✓	✓		✓	✓		✓	✓				✓		✓	
	Interaction - MOED x Pretest					✓					✓	✓		✓		✓

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* Coding for the categorical variables: WM = 1 for White, 0 for Minority; FMP = 1 for participant, 0 for non-participant; CE75 = 1 for receipt, 0 for non-receipt; NEED = 1 for need in CE, 0 for no need in CE; MOED = 1 for at least high school, 0 for less than high school; EXP = 1 to 10, representing intervals of approximately equal frequencies.

Table B5-2

Estimating and Cross-Validating the Regression Equation of Achievement Posttest Score on Pretest Score and Selected Student-Level Variables*

Grade	CE Availability in the School	NP**	Sample for Estimation			Sample for Cross-Validation					
			N	RSQ**	MSR**	N	RSQ**	MSR**	ASD**	r**	F**
					Reading						
1	Not Available	7	755	.48	1104.30	719	.50	1066.61	1087.95	.69	2.80
	Available	6	1,160	.44	1073.91	1,107	.42	1194.25	1202.13	.64	2.04
2	Not Available	4	577	.67	841.13	610	.66	922.39	960.40	.80	6.03
	Available	5	914	.65	854.63	978	.68	786.72	791.95	.82	2.08
3	Not Available	5	624	.73	825.73	649	.72	952.27	952.07	.85	.98
	Available	6	1,000	.71	850.13	981	.67	881.06	894.57	.81	3.15
4	Not Available	5	657	.75	1070.38	644	.76	892.07	890.46	.87	.81
	Available	8	1,018	.75	901.74	1,072	.73	918.20	935.69	.85	3.27
5	Not Available	9	742	.79	939.93	730	.80	1092.23	1154.39	.89	5.15
	Available	7	1,161	.80	852.67	1,124	.79	881.48	883.63	.89	1.34
6	Not Available	4	809	.84	871.94	801	.83	923.79	943.28	.91	4.38
	Available	8	1,471	.81	942.59	1,310	.79	906.15	927.10	.89	4.37
					Math						
1	Not Available	7	1,686	.48	1000.44	1,806	.50	1013.38	1014.72	.70	1.30
	Available	6	955	.46	1028.25	1,035	.48	1122.69	1141.67	.68	3.50
2	Not Available	6	1,569	.57	1008.91	1,572	.51	1225.28	1239.48	.71	3.60
	Available	5	861	.53	1074.64	811	.52	1284.00	1307.44	.71	3.47
3	Not Available	7	1,559	.57	1411.92	1,581	.58	1449.94	1452.08	.76	1.29
	Available	8	875	.52	1317.28	834	.51	1361.42	1362.72	.71	1.09
4	Not Available	6	1,659	.62	1541.11	1,639	.60	1687.14	1686.05	.78	.85
	Available	5	821	.58	1460.49	848	.58	1556.58	1563.23	.76	1.60
5	Not Available	7	1,943	.66	1756.50	1,875	.62	2009.25	2063.66	.78	7.35
	Available	7	858	.61	2146.27	916	.61	1953.85	2008.12	.77	4.16
6	Not Available	8	1,896	.69	2009.58	1,931	.67	2118.54	2164.73	.82	5.68
	Available	6	1,088	.68	1805.65	1,112	.62	2109.76	2129.32	.78	2.47
					Practical Achievement						
4	Not Available	7	640	.59	16.46	625	.60	17.06	17.46	.76	2.83
	Available	6	1,027	.59	16.55	1,034	.53	18.91	18.91	.73	.99
5	Not Available	7	729	.55	17.52	707	.56	17.43	17.47	.74	1.22
	Available	5	1,124	.53	15.85	1,051	.56	14.70	14.82	.74	2.34
6	Not Available	9	778	.67	10.35	768	.56	15.00	15.31	.74	2.57
	Available	7	1,281	.51	12.97	1,326	.46	12.46	12.69	.67	4.09

*Two random samples of non-CE students were drawn from schools where CE is not available in the subject area, one served as the estimation sample and the other served as the cross-validation sample. Similarly, two random samples of non-CE students were drawn from schools where CE is available in the subject area and used for the estimation and cross-validation of the regression model. For a list of the student-level variables involved in each case, please refer to Table B5-1.

**NP = number of predictors in the equation; RSQ = squared multiple correlation; MSR = mean squared residuals; ASD = average squared differences between the observed posttest score (y) and the predicted score (y_p) based on the regression equation obtained in the estimation sample; r = correlation between y and y_p; F = test of goodness of fit of the regression equation obtained from the estimation sample when applied to the cross-validation sample.

Table B5-3

Average Differences Between Observed and Predicted Scores for the Cross-Validation Sample by Student Characteristics, on the Basis of the Regression Equation Obtained from the Estimation Sample

GRADE	Availability of CE in the School	Race/Ethnicity		Free Meal		Mother's Education		Teacher Judgment	
		White/ Caucasian	Minority	Participant	Non-Participant	Less Than High School	High School or More	Need for CE	No Need for CE
	Reading								
1	Not Available	1.16*	-5.38*	1.77	-2.36	-.47	-1.41	1.04	-1.88
	Available	-.67	3.61	3.90	-1.19	-2.55	.86	-2.40	.67
2	Not Available	1.90	1.10	.50	2.10	-8.09*	3.55*	-5.73*	4.66*
	Available	-.66	-3.91	-5.22*	-.05*	-11.00*	.62*	-1.56	-1.31
3	Not Available	.34	-1.18	-5.23*	2.16*	-1.80	.32	-2.69	.72
	Available	-2.01	.87	-1.05	-1.52	-2.52	-1.16	3.99	-2.10
4	Not Available	1.75	-1.64	1.40	.58	2.92	.33	1.47	.58
	Available	-2.15	.65	-2.55	-1.19	3.93*	-2.98*	5.06*	-2.85*
5	Not Available	.23	-3.28	-3.49	.20	1.59	-1.38	1.19	-1.31
	Available	1.56	.97	-.84	2.33	3.89	.70	2.36	1.24
6	Not Available	-1.03	-5.70	-7.40*	-.66*	-2.25	-2.53	-9.94*	-.23*
	Available	-2.02*	4.24*	-.32	-.91	.04	-1.00	2.90	-1.49
	Math								
1	Not Available	-.50	1.15	-.14	-.10	-.70	.02	1.20	-.40
	Available	.13	-1.05	1.27	-.90	.96	-.52	-1.26	.01
2	Not Available	-1.14	-4.09	-5.54*	-.59*	-1.00	-2.07	-4.84	-1.27
	Available	.23	-2.78	-1.03	-.15	-1.99	-.03	8.60*	-1.85*
3	Not Available	1.17	-.97	1.01	.51	4.66	-.38	-.23	.88
	Available	-.18	-2.06	-1.38	-.29	1.39	-1.14	-7.48	.35
4	Not Available	.19	2.77	-.30	1.21	-.15	1.04	-1.74	1.45
	Available	2.07	5.03	1.38	3.42	3.50	2.58	-4.91	4.19
5	Not Available	-.48*	6.97*	.07	1.91	-1.96	2.27	.34	1.63
	Available	.53	4.48	4.09	.40	13.69*	-1.99*	7.81	.38
6	Not Available	-2.23	.11	-.62	-2.07	-3.19	-1.20	-.61	-1.95
	Available	.35	1.64	1.29	.41	-5.57*	2.50*	-.30	.84
	Practical Achievement								
4	Not Available	-.07	-.21	-.02	-.14	-.60	.00	-.36	.01
	Available	-.26	-.02	-.06	-.26	-1.09*	.03*	.21	-.29
5	Not Available	.33	-.24	-.60*	.44*	.33	.12	-.38	.29
	Available	.16	-.16	.38	-.06	.39	.00	-.36	.17
6	Not Available	-.14	.28	-.17	.05	.06	-.03	.86*	-.30*
	Available	.27	.31	.35	.25	.49	.22	.40	.25

*Group means differ significantly at the .01 level.

Comparing Posttest Achievement of CE Students with the Expectation. To assess the effectiveness of CE with respect to the standard derived from the prediction models, the observed mean performance of CE students was compared with the expected mean performance for a hypothetical group of non-CE students with identical characteristics. The comparisons were made for all CE students, for each of the three categories of CE students separately, and specifically for the subgroup of CE students in the nominated schools. As in the norm-referenced analyses, the purpose of the special analysis for the CE students from the nominated schools is to examine the consequences of combining them indiscriminately with the CE students from the representative schools in the evaluation of the general effects of CE.

Tables B5-4 and B5-5 present the results of these analyses for reading and math, respectively. The detection of the effects of CE follows a similar strategy for identification of outliers in the regression analyses. Explicitly, if the conditional sampling distribution of the predicted mean posttest score indicates a small likelihood (e.g., with probability of less than .1) for it to exceed the observed posttest score, then we consider it unlikely that the observed mean posttest score could have been obtained by the CE students without CE intervention. By this line of reasoning, an observed mean posttest score greater than the upper limit of the 80 percent credibility interval for the corresponding expected mean posttest score provides evidence for positive effects of CE. On the other hand, if the observed mean posttest score is smaller than the lower limit of the 80 percent credibility interval, we conclude that there is no evidence for positive effects of CE. If the observed mean falls between the interval, the evidence for effects of CE is inconclusive.

For an easier understanding of the results, we also computed the t-ratio (mean divided by its estimated standard error) for the difference between the observed and the predicted mean posttest scores. The magnitude of the t-ratio to be considered as an indication of positive effects of CE depends on the significance level. For example, a one-tailed significance test of .10 corresponds to a critical value of 1.28 for the sample sizes involved. It is important to note that the two lines of interpretations are not equivalent because the standard error of the observed mean is involved in the computation of the t-ratio, but not in the detection of outliers. However, the two interpretations generally agree with each other because of the large sample sizes. Our discussion, being decision-oriented, will follow the first interpretation.

- *Results for Reading.* Table B5-4 shows some evidence for overall positive effects of CE in grades 1 and 5 when Model A is used to set the standard, and in grade 6 when Model B is used. For the subgroups of CE students, the analysis with Model A reveals some positive effects in grades 1 and 5 for Title I students, and in grade 5 for other-CE students. The only noteworthy finding with Model B is the positive effects for Title I students in grade 1. For CE students in the nominated schools, positive effects of CE are obtained in grades 1 and 5 with both models and additionally in grade 3 with Model B. Thus there is no clear evidence that CE is particularly effective in the nominated schools.

Table B5-4

Mean Observed and Expected Posttest Reading VSS for All CE Students and by CE Category (Expected Posttest Scores Are Computed Based on the Regression Models Estimated from Two Samples of Non-CE Students in Reading CE and Non-CE Schools)*

GRADE	CE Status**	N	MEAN	REGRESSION MODEL A					REGRESSION MODEL B				
				PMEAN	SE of PMEAN	80% CI LOWER	80% CI UPPER	T RATIO	PMEAN	SE of PMEAN	80% CI LOWER	80% CI UPPER	T RATIO
1	ALL CE	2,448	389.72	386.72	1.92	384.26	389.18	1.47	388.76	2.04	386.16	391.37	.45
	TITLE I	1,565	387.63	380.82	2.14	378.08	383.57	2.96	383.41	2.17	380.63	386.20	1.81
	OCE/TI	524	396.58	399.17	1.56	397.18	401.16	-1.21	400.67	1.69	398.51	402.83	-1.84
	OCE/NTI	359	388.79	394.27	1.79	391.98	396.56	-2.19	394.70	2.12	391.99	397.42	-2.16
	CE/NOM	862	394.59	380.83	2.28	377.91	383.76	5.40	383.84	2.24	380.97	386.71	4.29
2	ALL CE	2,885	433.38	433.56	1.83	431.22	435.89	-.09	434.18	2.46	431.03	437.32	-.32
	TITLE I	1,829	427.17	427.54	1.97	425.03	430.06	-.18	428.52	2.84	424.88	432.15	-.46
	OCE/TI	626	448.83	450.38	1.48	448.49	452.27	-.83	450.70	1.63	448.61	452.78	-.93
	OCE/NTI	430	437.27	434.64	1.90	432.21	437.07	1.12	434.20	2.28	431.28	437.12	1.15
	CE/NOM	905	429.79	429.31	1.95	426.81	431.81	.22	431.60	2.76	428.06	435.13	-.62
3	ALL CE	2,707	458.86	461.00	1.77	458.73	463.26	-1.15	459.20	1.94	456.72	461.68	-.17
	TITLE I	1,782	453.88	454.80	1.94	452.32	457.28	-.45	452.77	2.12	450.06	455.48	.50
	OCE/TI	500	472.51	477.58	1.41	475.77	479.39	-2.65	477.02	1.51	475.10	478.95	-2.27
	OCE/NTI	425	463.65	467.46	1.67	465.31	469.60	-1.75	465.19	1.86	462.80	467.57	-.66
	CE/NOM	819	458.95	456.76	1.99	454.21	459.31	.98	455.33	2.10	452.64	458.03	1.55
4	ALL CE	2,214	481.96	483.29	2.05	480.66	485.92	-.62	481.01	2.27	478.11	483.92	.40
	TITLE I	1,354	475.02	475.15	2.31	472.20	478.10	-.05	472.86	2.52	469.64	476.08	.82
	OCE/TI	451	494.86	498.09	1.65	495.98	500.19	-1.43	497.66	1.66	495.54	499.78	-1.29
	OCE/NTI	409	490.70	493.94	1.83	491.60	496.28	-1.33	489.65	2.28	486.74	492.57	.39
	CE/NOM	522	469.49	474.39	2.24	471.52	477.26	-1.84	472.06	2.49	468.86	475.25	-.91
5	ALL CE	2,093	501.27	490.04	3.76	485.23	494.85	2.94	501.71	1.81	499.40	504.02	-.23
	TITLE I	1,275	495.12	483.17	4.00	478.05	488.28	2.93	495.58	1.92	493.12	498.03	-.22
	OCE/TI	425	513.29	506.87	3.03	503.00	510.75	1.90	516.23	1.59	514.20	518.26	-1.39
	OCE/NTI	393	508.21	494.12	3.82	489.23	499.02	3.42	505.90	1.72	503.70	508.11	1.02
	CE/NOM	506	494.26	486.09	3.89	481.12	491.06	1.98	496.99	1.91	494.54	499.44	-1.18
6	ALL CE	2,105	527.96	532.31	1.46	530.45	534.18	-2.74	523.96	2.01	521.38	526.53	1.89
	TITLE I	1,164	518.62	521.85	1.62	519.78	523.93	-1.76	512.07	2.30	509.13	515.02	2.65
	OCE/TI	581	552.59	555.07	1.22	553.51	556.63	-1.43	550.63	1.43	548.80	552.47	1.02
	OCE/NTI	360	518.38	529.42	1.45	527.56	531.28	-5.19	519.32	2.11	516.63	522.02	-.35
	CE/NOM	493	527.31	528.02	1.61	525.96	530.08	-.34	518.46	2.32	515.49	521.43	3.28

* Regression Model A - model estimated from a sample of students in reading non-CE schools;
Regression Model B - model estimated from a sample of non-CE students in reading CE schools;
PMEAN - predicted mean based on the regression model; SE - standard error; CI - credibility interval;
T RATIO - ratio of the difference between the observed and predicted means to the SE of the difference.

** OCE/TI - other reading CE students in Title I schools; OCE/NTI - other reading CE students in non-Title I schools; CE/NOM - any reading CE students in the nominated schools.

Table B5-5

Mean Observed and Expected Posttest Math VSS for all CE Students and by CE Category (Expected Posttest Scores Are Computed Based on the Regression Models Estimated from Two Samples of Non-CE Students in Math CE and Non-CE Schools)*

GRADE	CE Status**	N	MEAN	REGRESSION MODEL A					REGRESSION MODEL B				
				PMEAN	SE of PMEAN	80% CI LOWER	80% CI UPPER	T RATIO	PMEAN	SE of PMEAN	80% CI LOWER	80% CI UPPER	T RATIO
1	ALL CE	1,420	379.08	371.54	1.32	369.85	373.23	4.82	377.43	1.69	375.27	379.60	.87
	TITLE I	780	374.53	362.75	1.61	360.69	364.82	5.98	369.79	2.03	367.19	372.39	2.03
	OCE/TI	429	385.86	384.62	.99	383.36	385.89	.68	389.50	1.26	387.89	391.12	-1.83
	OCE/NTI	211	382.11	377.40	1.29	375.75	379.06	1.86	381.15	1.62	379.07	383.23	.35
	CE/NOM	494	388.01	368.24	1.63	366.16	370.32	9.14	376.13	1.86	373.75	378.50	5.05
2	ALL CE	1,605	429.13	427.95	1.26	426.33	429.56	.80	432.08	2.88	428.40	435.76	-.99
	TITLE I	924	421.08	419.10	1.45	417.24	420.96	1.11	424.39	3.34	420.11	428.67	-.94
	OCE/TI	514	441.29	441.13	1.02	439.82	442.43	.09	444.07	2.02	441.48	446.66	-1.12
	OCE/NTI	167	436.24	436.32	1.17	434.82	437.81	-.03	437.74	3.57	433.17	442.32	-.34
	CE/NOM	553	428.39	424.50	1.43	422.67	426.34	1.98	432.07	2.93	428.32	435.82	-1.13
3	ALL CE	1,659	471.86	463.66	3.82	458.78	468.55	2.09	476.69	2.26	473.79	479.58	-1.98
	TITLE I	975	467.[illegible]9	452.24	4.69	446.24	458.24	3.17	468.76	2.67	465.34	472.18	-.40
	OCE/TI	420	478.15	482.41	1.69	480.24	484.58	-1.71	488.44	1.78	486.16	490.73	-4.10
	OCE/NTI	264	477.62	476.03	4.32	470.49	481.56	.33	487.25	1.84	484.90	489.60	-3.33
	CE/NOM	579	469.17	457.99	4.40	452.36	463.61	2.40	474.16	2.67	470.74	477.57	-1.63
4	ALL CE	1,425	511.89	514.29	1.48	512.39	516.18	-1.32	518.95	2.04	516.34	521.55	-3.10
	TITLE I	725	503.93	502.38	1.75	500.14	504.62	.68	508.75	2.34	505.75	511.75	-1.76
	OCE/TI	436	526.53	528.78	1.19	527.25	530.30	-1.01	530.58	1.75	528.34	532.82	-1.60
	OCE/NTI	264	509.57	523.05	1.44	521.21	524.90	-4.79	527.73	1.88	525.32	530.14	-6.03
	CE/NOM	368	504.81	504.89	1.70	502.71	507.07	-.03	509.40	2.51	506.18	512.61	-1.43
5	ALL CE	1,376	541.95	538.09	1.71	535.90	540.28	1.88	540.52	2.96	536.73	544.30	.45
	TITLE I	740	536.23	528.82	1.89	526.40	531.24	3.04	531.23	3.27	527.04	535.43	1.35
	OCE/TI	384	554.15	554.28	1.50	552.37	556.20	-.05	557.58	2.53	554.33	560.82	-.99
	OCE/NTI	252	540.13	540.65	1.59	538.61	542.68	-.17	541.78	2.87	538.10	545.45	-.40
	CE/NOM	391	539.70	533.50	1.83	531.15	535.84	2.22	537.42	3.06	533.51	541.34	.59
6	ALL CE	1,465	578.34	573.90	1.69	571.74	576.07	2.16	573.76	3.16	569.71	577.81	1.37
	TITLE I	651	573.32	561.90	2.05	559.28	564.53	4.23	561.05	4.23	555.63	566.47	2.70
	OCE/TI	559	590.48	590.07	1.44	588.23	591.91	.17	591.31	1.94	588.82	593.79	-.31
	OCE/NTI	255	564.56	569.10	1.78	566.82	571.38	-1.37	567.73	3.57	563.16	572.29	-.71
	CE/NOM	383	582.79	568.52	2.11	565.83	571.22	4.58	572.86	3.49	568.40	577.32	2.42

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*Regression Model A - model estimated from a sample of students in math non-CE schools.
Regression Model B - model estimated from a sample of non-CE students in math CE schools;
PMEAN - predicted mean based on the regression model; SE - standard error; CI - credibility interval;
T RATIO - ratio of the difference between the observed and predicted means to the SE of the difference.

**OCE/TI - other math CE students in Title I schools; OCE/NTI - other math CE students in non-Title I schools; CE/NOM - any math CE students in the nominated schools.

These results for reading suggest that uses of models that explicitly take student characteristics into account produce slightly more stringent standards in grades 2 and 3. In these two grades, no positive effects of CE are evident in the current analyses, but positive effects were indicated in some previous analyses using other standards. In contrast, adjustment of student characteristics results in some detectable positive effects of CE in grade 5 that were not noticeable in some of the previous analyses.

- *Results for Math.* Positive overall CE effects in grades 1, 3, 5, and 6 are observed in Table B6-5, when Model A is employed. However, the results show positive effects only in grade 6 when Model B is used. For the three categories of CE students, there is evidence for positive effects of CE on the achievement growth of Title I students in grades 1, 3, 5, and 6 when Model A is applied, and on the growth of other-CE students in other-CE schools in grade 1. With Model B, only a few positive effects are obtained in grades 5 and 6 for Title I students. For the CE students in the nominated schools, the analyses with Model A show positive effects in all grades but grade 4, while the analyses with Model B reveal positive effects only in grades 1 and 5. Again, it is not apparent that CE in math is more effective in the nominated schools.

In summary, the application of statistical models to set comparison standards results in fewer instances of positive CE effects, particularly when the model is developed from data for non-CE students in CE schools. This model may have set unusually high standards for the detection of CE effects because its validity is affected by the lack of data in the lower end of the pretest score distribution. This suspicion stems from the finding that this model gives less satisfactory predictions for the performance of educationally needy non-CE students than the model (Model A) developed with data from non-CE schools (see Tables E-1 and E-2 of Appendix E). The results of analyses with Model A generally confirm the findings of other analyses using different approaches.

Analysis for Practical Achievement

The practical achievement scores for CE students in grades 4 to 6 were also analyzed with this approach. As for the reading and math analyses, the variables employed in the two prediction models are listed in Table B5-1, and the results of cross-validating the models are reported in Table B5-2 and B5-3. Table B5-6 presents the data required for evaluating the effects of CE based on these models, while the findings from these analyses are discussed in the text.

Table B5-6

Mean Observed and Expected Posttest Practical Achievement Scores for All CE Students and by CE Cagegory (Expected Posttest Scores Are Computed Based on the Regression Models Estimated from Two Samples of Non-CE Students in CE and Non-CE Schools)*

GRADE	CE Status**	N	MEAN	REGRESSION MODEL A PMEAN	SE of PMEAN	80% CI LOWER	80% CI UPPER	T RATIO	REGRESSION MODEL B PMEAN	SE of PMEAN	80% CI LOWER	80% CI UPPER	T RATIO
4	ALL CE	2,514	14.31	14.62	.56	13.90	15.35	-.55	14.63	.24	14.32	14.93	-1.28
	TITLE I	1,571	13.75	13.92	.61	13.15	14.70	-.29	13.90	.26	13.56	14.23	-.53
	OCE/TI	507	15.43	15.78	.44	15.22	16.34	-.75	15.89	.19	15.65	16.13	-1.79
	OCE/NTI	436	15.03	15.80	.57	15.07	16.54	-1.27	15.78	.21	15.51	16.05	-2.62
	CE/NOM	603	13.55	14.03	.62	13.24	14.82	-.75	13.86	.27	13.51	14.20	-.95
5	ALL CE	2,411	16.80	16.80	.29	16.44	17.17	-.02	17.63	.24	17.32	17.95	-3.25
	TITLE I	1,498	16.27	16.34	.30	15.95	16.73	-.23	17.15	.26	16.82	17.48	-3.17
	OCE/TI	504	17.94	17.77	.25	17.45	18.09	.53	18.60	.21	18.33	18.87	-2.41
	OCE/NTI	409	17.34	17.30	.28	16.94	17.65	.12	18.21	.24	17.91	18.51	-2.84
	CE/NOM	632	15.97	16.85	.30	16.46	17.24	-2.54	17.38	.24	17.07	17.69	-4.88
6	ALL CE	2,398	19.15	18.17	.36	17.71	18.63	2.67	19.11	.25	18.78	19.43	.15
	TITLE I	1,335	18.42	17.11	.43	16.56	17.66	2.99	18.25	.30	17.87	18.64	.54
	OCE/TI	667	20.69	20.18	.24	19.88	20.49	1.87	20.77	.17	20.55	20.99	-.35
	OCE/NTI	396	19.01	18.37	.35	17.92	18.81	1.67	19.21	.25	18.89	19.53	-.66
	CE/NOM	600	18.71	17.52	.39	17.01	18.02	2.86	18.78	.28	18.42	19.15	-.25

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[*] Regression Model A - model estimated from a sample of students in non-CE schools;
Regression Model B - model estimated from a sample of non-CE students in CE schools;
PMEAN - predicted mean based on the regression model; SE - standard error; CI - credibility interval;
T RATIO - ratio of the difference betwen the observed and predicted means to the SE of the difference.

[**] OCE/TI - other CE students in Title I schools; OCE/NTI - other CE students in Non-Title I schools;
CE/NOM - any CE students in the nominated schools.

APPENDIX C

MATERIALS SUPPORTING CHAPTER 3

C 1 Supplementary Tables for Chapter 3

C 2 Mathematical Formulations of Structural-Relation Models Employed in Chapter 3

APPENDIX C1

SUPPLEMENTARY TABLES FOR CHAPTER 3

Table C1-1

Projected Population Mean Proportions of Each Service Composite for Reading and Math, by Grade

Service Composite	Projected Population Mean Proportions*					
	Gr. 1	Gr. 2	Gr. 3	Gr. 4	Gr. 5	Gr. 6
			Reading			
H_R (regular)	.46	.42	.44	.49	.48	.47
H_S (special)	.20	.21	.20	.18	.16	.17
H_I (independent)	.34	.37	.36	.33	.36	.36
			Math			
H_R (regular)	.53	.50	.54	.55	.54	.59
H_S (special)	.10	.13	.11	.13	.15	.11
H_I (independent)	.37	.37	.35	.32	.31	.30

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* These proportions are used to construct patterns of service delivery. (See the text in Chapter 3 for explanations.)

Table C1-2

Changes in Correlations Between Achievement and the Standard-Resource-Dollar (SRD) Measure of Instructional Services Received During the Year, for Subsamples of Students Classified by Pattern of Instructional Services†

Grade	Correlation Between Services Measured by SRD's and Pretest/Posttest Achievement	Subsamples by Pattern of Instructional Services*						Total Sample
		+--	-+-	++-	--+	+-+	-++	
	Reading Achievement and Services							
1	Pretest	.01	.06	.00	.07	.08	.01	-.07
	Posttest	.07	.05	.02	.11	.11	.04	-.07
	t_{diff}**	4.81	-0.81	0.86	1.86	2.10	2.24	1.05
2	Pretest	-.07	.00	.11	-.13	-.05	.03	-.17
	Posttest	-.08	.01	.07	-.10	-.02	-.00	-.17
	t_{diff}**	-0.95	0.71	-1.45	1.53	2.92	-2.37	1.16
3	Pretest	-.10	-.01	.02	-.21	-.19	-.05	-.28
	Posttest	-.10	.01	.02	-.18	-.20	.00	-.26
	t_{diff}**	0.28	1.55	-0.14	2.11	-0.82	3.86	4.50
4	Pretest	-.17	-.11	-.08	-.18	-.10	-.20	-.33
	Posttest	-.16	-.09	-.14	-.19	-.09	-.16	-.32
	t_{diff}**	1.64	0.93	-2.76	-1.25	1.27	3.58	4.59
5	Pretest	-.17	-.08	-.10	-.14	-.18	-.13	-.29
	Posttest	-.16	-.06	-.06	-.12	-.18	-.12	-.28
	t_{diff}**	1.93	1.51	2.21	2.66	0.25	0.36	2.98
6	Pretest	-.18	-.21	-.27	-.15	-.13	-.18	-.30
	Posttest	-.14	-.16	-.20	-.15	-.12	-.18	-.27
	t_{diff}**	7.36	4.32	5.43	0.42	1.06	0.82	8.24
	Math Achievement and Services							
1	Pretest	-.03	-.00	.04	-.08	.02	-.07	-.14
	Posttest	-.00	.04	.09	-.05	.06	-.01	-.09
	t_{diff}**	2.01	2.26	2.12	2.54	1.83	3.11	7.72
2	Pretest	-.11	-.14	-.04	.05	.07	-.04	-.14
	Posttest	-.14	-.13	-.01	.10	.05	-.01	-.13
	t_{diff}**	-2.82	0.85	1.04	4.22	-0.90	1.78	1.04
3	Pretest	.01	-.01	-.05	-.02	-.10	-.06	-.15
	Posttest	.00	.03	-.11	-.03	-.14	-.03	-.16
	t_{diff}**	-0.23	2.54	-2.57	-0.79	-2.08	1.64	-2.25
4	Pretest	-.13	-.13	-.04	-.02	.01	-.09	-.21
	Posttest	-.17	-.03	-.02	-.02	.03	-.02	-.17
	t_{diff}**	-3.75	4.96	0.72	-0.02	0.69	5.24	6.19
5	Pretest	-.07	.04	.03	-.09	.02	-.12	-.19
	Posttest	-.07	.04	.08	-.08	.05	-.08	-.17
	t_{diff}**	0.30	0.11	1.61	1.74	1.77	3.52	3.43
6	Pretest	-.05	-.06	-.04	-.03	-.03	-.13	-.18
	Posttest	-.03	-.02	.06	-.01	-.09	-.13	-.15
	t_{diff}**	3.28	2.54	4.76	2.12	-3.16	0.58	6.75

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† The standard-resource-dollar measure of instructional services is explained in Report 6.

* The hours of instruction received during the 1976-77 school year were employed to form six patterns of instructional services. The instructional services were grouped into three kinds: regular instruction (by classroom teachers in groups of 7 or more), special instruction (by special teachers, paid aides/assistants, or by classroom teachers in groups of 1-6), and tutor/independent work. Three variables representing the proportions of hours of instruction received in each of the three kinds of services were created and then each was dichotomized at the corresponding estimated population value. Because the proportions sum to 1.0, six mutually exclusive patterns of services were obtained on the basis of three dichotomies, excluding the rare cases where each proportion was equal to its respective cutoff (mostly due to roundings). In the Table, a '+' indicates the proportion is above the cutoff, while a '-' indicates a value below the cutoff. The instructional patterns are represented by the three indexes of '+/-' for regular instruction, special instruction, and tutor/independent work (arranged from left to right). For example, the pattern '+--' indicates that the proportion of regular instructional time is above its cutoff, while the proportions of special instruction and tutor/independent work are below their respective cutoffs.

** Hotelling's t statistic for the difference between the pair of correlations.

Table C1-3

Average Pretest Scores, VSS Gains, Total Hours of Instructional Services Received, and Standard-Resource Dollar Indexes in Reading for the 1976-77 School Year, by Grades and Patterns of Instructional Services*

Grade	Patterns of Instructional Services	Hours of Instructions Received as Indicators of Services				Standard-Resource-Dollars as Indicators of Services			
		N**	Pretest VSS	F-S VSS Gain	Hrs. of Service	N**	Pretest VSS	F-S VSS Gain	Service Costs
1	+--	4,551	346.3	67.5	302.1	4,488	346.3	67.9	294.6
	-+-	2,822	330.9	58.9	280.0	2,810	330.9	58.8	495.2
	++-	1,543	336.8	62.9	301.3	1,536	336.9	63.0	375.1
	--+	2,347	351.2	66.3	309.9	2,282	351.2	66.5	271.3
	+-+	2,863	352.9	69.2	321.9	2,848	352.9	69.2	271.4
	-++	2,670	345.2	61.2	294.4	2,630	344.9	61.2	424.6
	Total	16,815	344.4	64.8	301.3	16,594	344.4	64.9	349.4
2	+--	4,229	422.7	44.2	291.7	4,194	422.5	44.2	286.8
	-+-	2,820	393.3	42.2	281.8	2,734	393.9	42.4	529.3
	++-	1,200	388.3	41.7	292.9	1,197	388.3	41.8	393.5
	--+	1,878	428.9	41.9	271.3	1,821	428.8	42.0	253.6
	+-+	3,014	433.0	43.2	296.2	2,996	432.9	43.3	254.8
	-++	2,232	411.2	43.4	264.4	2,164	411.4	43.5	400.3
	Total	15,374	415.7	43.1	284.4	15,107	415.8	43.1	345.1
3	+--	3,997	469.4	32.9	239.1	3,908	470.3	32.9	232.4
	-+-	2,620	426.3	32.7	242.2	2,511	426.0	33.2	462.9
	++-	1,164	429.4	36.3	275.6	1,141	429.8	36.4	352.9
	--+	2,221	475.9	32.6	245.1	2,095	476.8	32.5	219.6
	+-+	2,899	484.6	34.5	245.7	2,881	484.7	34.6	209.0
	-++	2,397	450.5	34.4	247.9	2,336	450.6	34.7	364.2
	Total	15,300	459.8	33.6	245.9	14,874	460.3	33.8	294.9
4	+--	4,712	501.1	29.4	203.4	4,679	500.8	29.5	185.1
	-+-	1,870	448.6	31.0	221.0	1,797	448.4	31.2	443.3
	++-	930	459.2	31.6	243.6	918	459.3	31.5	343.7
	--+	2,614	514.0	29.8	198.1	2,496	514.7	29.9	167.7
	+-+	2,768	512.6	28.7	202.6	2,745	512.3	28.7	172.8
	-++	2,435	479.7	29.3	217.2	2,310	479.4	29.6	322.2
	Total	15,330	493.0	29.7	209.1	14,946	493.1	29.8	241.9
5	+--	5,423	529.4	28.9	188.2	5,372	529.3	28.9	162.6
	-+-	1,968	479.7	24.6	207.3	1,854	478.7	25.1	417.8
	++-	1,114	491.6	25.9	220.8	1,086	491.8	25.9	302.0
	--+	2,505	544.6	27.1	192.6	2,362	544.5	27.2	161.2
	+-+	3,014	542.4	27.2	194.7	2,924	541.9	27.3	157.1
	-++	2,031	514.4	26.0	208.6	1,969	515.6	26.2	303.7
	Total	16,057	523.6	27.2	197.3	15,569	523.6	27.3	219.3
6	+--	6,831	564.5	24.8	169.8	6,752	565.1	24.9	142.0
	-+-	2,235	518.0	24.6	184.3	2,133	519.0	24.6	342.9
	++-	1,341	518.9	23.7	211.8	1,298	520.3	23.5	283.6
	--+	2,494	576.9	26.7	184.8	2,423	577.4	26.9	145.9
	+-+	3,592	568.8	25.5	185.0	3,428	569.7	25.4	146.9
	-++	2,076	541.2	25.2	187.2	2,065	541.2	25.1	273.3
	Total	18,570	555.5	25.1	181.5	18,100	556.2	25.1	192.3

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*Patterns of instructional services are described in terms of the proportional distributions of hours received in three kinds of instructions - regular, special, and independent ('+/-' indicates higher/lower proportion relative to the population estimates). For detailed explanations, see footnote of Table C1-2. Gains are measured from fall to spring of the school year.

**Due to exclusions of cases with all three proportions equal to the cutoffs from the pattern categories, total N may sometimes be slightly larger than the sum of N's for the six patterns. The samples for analyses of the two different service indicators are not exactly identical because of differential missing data for the two indicators.

Table C1-4

Average Pretest Scores, VSS Gains, Total Hours of Instructional Services Received, and Standard-Resource-Dollar Indexes in Math for the 1976-77 School Year, by Grades and Patterns of Instructional Services*

Grade	Patterns of Instructional Services	Hours of Instructions Received as Indicators of Services				Standard-Resource-Dollars as Indicators of Services			
		N**	Pretest VSS	F-S VSS Gain	Hrs. of Service	N**	Pretest VSS	F-S VSS Gain	Service Costs
1	+--	5,230	333.4	61.0	160.8	5,151	333.2	61.1	111.9
	-+-	2,247	315.2	60.2	170.9	2,246	315.2	60.2	238.2
	++-	1,323	322.5	60.6	163.0	1,305	322.7	60.7	172.5
	--+	4,153	337.4	62.2	165.8	4,094	337.4	62.3	103.1
	+-+	1,444	338.9	61.6	153.6	1,441	338.9	61.7	101.8
	-++	2,378	328.9	63.2	164.0	2,357	328.9	63.2	177.6
	Total	16,775	330.9	61.5	163.4	16,594	330.9	61.6	140.1
2	+--	4,708	392.3	57.8	175.9	4,665	392.3	57.8	129.8
	-+-	1,893	378.3	53.9	175.8	1,866	378.6	54.0	256.4
	++-	808	380.5	53.4	184.0	786	381.6	53.0	211.9
	--+	3,934	400.3	54.5	155.2	3,885	400.1	54.5	104.5
	+-+	2,246	401.7	55.6	170.7	2,243	401.7	55.6	110.0
	-++	1,741	387.8	53.0	168.6	1,680	388.2	53.5	210.2
	Total	15,332	392.8	55.4	169.4	15,127	393.0	55.4	149.2
3	+--	4,439	447.8	57.9	167.3	4,284	447.4	58.6	118.0
	-+-	1,821	423.5	52.2	189.2	1,744	422.9	52.5	273.8
	++-	854	422.2	53.4	188.6	839	421.9	53.8	199.7
	--+	4,165	452.7	61.3	169.2	4,160	452.7	61.3	111.6
	+-+	1,650	448.5	60.1	164.3	1,634	448.8	60.3	110.2
	-++	2,333	436.7	53.1	171.1	2,269	437.3	53.5	198.2
	Total	15,262	443.2	57.4	171.9	14,930	443.2	57.8	150.4
4	+--	5,336	498.8	49.3	166.1	5,284	498.6	58.4	118.6
	-+-	1,297	457.5	49.0	196.1	1,237	458.3	49.6	332.6
	++-	788	472.5	51.2	189.2	763	472.3	50.7	208.1
	--+	3,996	508.0	50.6	167.8	3,906	507.9	50.8	114.8
	+-+	1,498	503.5	50.6	169.2	1,464	503.6	50.7	112.4
	-++	2,380	487.0	51.7	174.7	2,330	487.3	51.7	219.5
	Total	15,295	495.0	50.2	171.9	14,984	495.1	50.3	154.9
5	+--	6,252	546.7	44.8	163.6	6,149	546.9	44.7	114.6
	-+-	1,416	505.3	40.2	193.8	1,395	505.5	40.3	338.5
	++-	631	507.3	41.3	187.3	626	507.3	41.3	231.7
	--+	3,682	550.8	44.6	172.0	3,554	551.6	45.0	118.7
	+-+	1,799	551.4	46.4	169.9	1,756	551.0	46.4	118.4
	-++	2,255	522.7	43.8	177.7	2,178	523.1	44.1	237.9
	Total	16,036	539.6	44.3	171.8	15,659	539.8	44.4	157.7
6	+--	7,715	591.1	39.2	161.6	7,373	591.2	39.8	113.2
	-+-	1,640	550.7	40.9	176.9	1,626	551.0	40.9	294.5
	++-	807	559.1	38.0	173.1	803	559.7	37.9	207.5
	--+	4,213	592.0	40.8	162.6	4,016	592.8	41.1	106.1
	+-+	1,683	588.1	40.0	165.4	1,631	587.6	41.1	107.8
	-++	2,470	562.4	40.5	165.2	2,448	562.6	40.4	208.0
	Total	18,529	582.2	39.9	164.5	17,898	582.2	40.3	144.8

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[*] Patterns of instructional services are described in terms of the proportional distribtuions of hours received in three kinds of instructions - regular, special, and independent ('+/-' indicates higher/lower proportion relative to the population estimates). For detailed explanations, see footnote of Table C1-2. Gains are measured from fall to spring of the school year.

[**] Due to exclusions of cases with all three proportions equal to the cutoffs from the pattern categories, total N may sometimes be slightly larger than the sum of N's for the six patterns. The samples for analyses of the two different service indicators are not exactly identical because of differential missing data for the two indicators.

Table C1-5

Definition of CE Comparison Groups for the Multiple Regression Analyses of the Practical Achievement Scale

CE Comparison Category in Reading*	CE Comparison Category in Math*				
	TI/TI	OCE/TI	OCE/OCE	NCE/CE	NCE/NCE
TI/TI	TI/TI	TI/TI	TI/TI	TI/TI	TI/TI
OCE/TI	TI/TI	OCE/TI	OCE/TI	OCE/TI	OCE/TI
OCE/OCE	TI/TI	OCE/TI	OCE/OCE	OCE/OCE	OCE/OCE
NCE/CE	TI/TI	OCE/TI	OCE/OCE	NCE/CE	NCE/CE
NCE/NCE	TI/TI	OCE/TI	OCE/OCE	NCE/CE	NCE/NCE

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*TI/TI = Title I students in Title I schools; OCE/TI = Other-CE students in Title I schools; OCE/OCE = Other-CE students in other-CE schools; NCE/CE = Needy non-CE students in CE schools; and NCE/NCE = Needy non-CE students in non-CE schools.

Table C1-6

Average Experience and Training for Regular and Special Teachers in Reading and Math by Grades Taught†

Grade Taught	Variables Describing Teacher's Qualification*	Type of Reading Teacher†					Type of Math Teacher†				
		Regular/ in Class	Special/ in Class	Special/ Additional	Total	% Variance Accounted for by Types	Regular/ in Class	Special/ in Class	Special/ Additional	Total	% Variance Accounted for by Types
1	N	898	34	145	1,077		826	10	54	890	
	Number of years teaching in any school	11.03	9.62	10.84	10.96	.10	11.11	7.00	9.26	10.95	.61
	Number of years teaching in current school	6.82	5.09	5.56	6.59	.78	6.84	4.00	5.17	6.71	.72
	Highest earned college degree	2.37	2.47	2.61	2.41	2.45**	2.35	2.40	2.56	2.37	.91
	Number of college courses in teaching	1.31	1.29	2.41	1.46	4.57**	.48	.20	1.30	.53	4.05**
	Number of hours of inservice training	10.92	11.41	23.28	12.60	5.63**	6.00	11.70	21.80	7.03	7.82**
2	N	866	55	188	1,109		776	17	62	855	
	Number of years teaching in any school	11.37	8.31	10.86	11.13	.76	11.67	7.88	9.44	11.44	.95
	Number of years teaching in current school	7.18	4.64	5.55	6.78	1.73**	7.37	4.29	4.81	7.13	1.61**
	Highest earned college degree	2.42	2.44	2.68	2.47	3.31**	2.43	2.53	2.55	2.44	.44
	Number of college courses in teaching	1.18	1.55	2.26	1.38	5.63**	.52	.53	1.24	.57	3.15**
	Number of hours of inservice training	11.13	10.45	22.41	13.01	5.13**	6.86	7.53	19.63	7.80	4.94**
3	N	861	47	214	1,122		771	18	81	870	
	Number of years teaching in any school	11.36	7.26	11.58	11.23	1.11**	11.36	6.44	9.27	11.07	1.33**
	Number of years teaching in current school	6.90	4.40	5.78	6.58	1.26**	6.94	4.78	5.16	6.73	1.06**
	Highest earned college degree	2.45	2.40	2.65	2.49	2.37**	2.44	2.56	2.54	2.46	.37
	Number of college courses in teaching	1.18	1.85	2.14	1.39	5.28**	.56	.83	1.11	.62	2.26**
	Number of hours of inservice training	9.52	11.87	19.97	11.62	5.67**	6.40	4.67	15.26	7.19	3.70**
4	N	813	63	197	1,073		725	31	84	840	
	Number of years teaching in any school	11.46	8.73	11.43	11.29	.69	11.59	8.48	9.67	11.29	1.06
	Number of years teaching in current school	7.05	4.71	5.53	6.63	1.75**	7.19	4.61	5.27	6.90	1.56**
	Highest earned college degree	2.45	2.60	2.68	2.50	3.06**	2.47	2.55	2.51	2.48	.13
	Number of college courses in teaching	1.11	1.68	2.24	1.35	7.22**	.62	.61	1.25	.68	2.76**
	Number of hours of inservice training	9.89	15.05	19.42	11.94	4.50**	6.70	9.03	16.81	7.80	4.20**
5	N	784	52	161	997		703	40	78	821	
	Number of years teaching in any school	11.45	9.40	10.50	11.19	.52	11.34	7.15	9.36	10.95	1.93**
	Number of years teaching in current school	7.27	5.06	5.26	6.83	2.15**	7.24	4.38	4.73	6.86	2.73**
	Highest earned college degree	2.51	2.46	2.65	2.53	1.20**	2.52	2.48	2.49	2.51	.06
	Number of college courses in teaching	1.11	1.77	2.09	1.31	5.19**	.64	.70	1.08	.68	1.22**
	Number of hours of inservice training	9.73	10.38	18.96	11.25	4.02**	6.40	8.23	16.28	7.43	4.55**
6	N	673	70	136	879		591	56	62	709	
	Number of years teaching in any school	10.98	9.59	10.44	10.79	.30	10.85	8.70	11.08	10.70	.64
	Number of years teaching in current school	6.81	5.04	5.07	6.40	1.76**	6.67	4.73	5.29	6.39	1.37**
	Highest earned college degree	2.52	2.53	2.66	2.54	.99	2.51	2.54	2.48	2.51	.04
	Number of college courses in teaching	1.06	1.64	2.13	1.27	5.99**	.66	.89	1.08	.72	1.21
	Number of hours of inservice training	8.96	15.31	19.18	11.05	5.17**	6.37	9.30	17.08	7.54	4.37**

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† The samples of teachers for different grades and different subject areas (reading/math) need not be independent, because many teachers taught both reading and math, and in more than one grade. Grades and subject areas taught were determined on the basis of Student-Teacher Linkage Roster. Teachers were designated as regular teacher providing instruction in classes, special teachers providing instruction in classes, or special teachers providing instruction in addition to regular classes according to their responses to the teacher questionnaires. Teachers whose responses could not be verified by their students' receipt of instruction in the respective category were excluded in the present analyses.

* Data describing teacher's qualification were collected in school year 1976-77. Highest earned college degree has been recoded as: 1 = less than 4 years of college work; 2 = bachelor's degree; 3 = 5th year preparation, master's degree, or 6-year specialist degree; and 4 = doctor's degree. Number of college courses and hours of staff development/inservice training represent the amount received in the respective subject area (reading/math) during the last three years (i.e., from 1973 to 1976 school year).

** Differences among the three types of teachers are significant at the .01 level.

Table C1-7

Correlations Among Achievement, Socio-Cultural Advantage Factor, CE Status, and Instructional Services Received for Reading (Above-Diagonal Entries) and Math (Below-Diagonal Entries), as Estimated from the Postulated Path Model

Latent or Observed Variables[*]	Grade 1 (N = 11,920 for Reading; 11,883 for Math)							Grade 2 (N = 10,997 for Reading; 10,973 for Math)						
	POST	PRE	SCAF	CE	HR	HS	HI	POST	PRE	SCAF	CE	HR	HS	HI
Posttest (POST)		.93	.49	-.30	.13	-.19	.16		.98	.58	-.41	.15	-.29	.16
Pretest (PRE)	.87		.59	-.33	.07	-.20	.16	.89		.57	-.44	.13	-.29	.18
Socio-Cultural Advantage Factor (SCAF)	.43	.49		-.37	.08	-.15	.23	.47	.48		-.37	.05	-.15	.17
CE Status (CE)	-.17	-.19	-.35		-.17	.38	-.14	-.23	-.22	-.39		-.10	.39	-.19
Hours of Regular Instruction (HR)	.06	.05	.04	-.13		-.47	-.07	.08	.03	-.04	-.12		-.46	-.08
Hours of Special Instruction (HS)	-.18	-.22	-.28	.37	-.35		-.13	-.17	-.15	-.23	.32	-.38		-.09
Hours of Tutor/Independent Work (HI)	.10	.08	.12	-.13	-.14	-.03		.06	.10	.07	-.05	-.17	-.01	

Latent or Observed Variables[*]	Grade 3 (N = 10,995 for Reading; 10,989 for Math)							Grade 4 (N = 10,846 for Reading; 10,821 for Math)						
	POST	PRE	SCAF	CE	HR	HS	HI	POST	PRE	SCAF	CE	HR	HS	HI
Posttest (POST)		.95	.65	-.48	.08	-.38	.13		.96	.61	-.43	.08	-.37	.06
Pretest (PRE)	.88		.64	-.48	.09	-.38	.13	.90		.61	-.43	.08	-.38	.07
Socio-Cultural Advantage Factor (SCAF)	.49	.52		-.39	-.01	-.21	.09	.51	.50		-.35	-.00	-.28	.01
CE Status (CE)	-.29	-.31	-.38		-.09	.47	-.16	-.29	-.28	-.30		-.10	.51	-.03
Hours of Regular Instruction (HR)	.09	.05	-.07	-.08		-.41	-.19	.05	.03	-.03	-.09		-.40	-.38
Hours of Special Instruction (HS)	-.22	-.21	-.25	.43	-.40		-.06	-.21	-.24	-.22	.37	-.43		-.03
Hours of Tutor/Independent Work (HI)	.08	.08	.13	-.08	-.39	-.04		.06	.06	.05	.05	-.51	.04	

Latent or Observed Variables[*]	Grade 5 (N = 11,600 for Reading; 11,585 for Math)							Grade 6 (N = 13,253 for Reading; 13,226 for Math)						
	POST	PRE	SCAF	CE	HR	HS	HI	POST	PRE	SCAF	CE	HR	HS	HI
Posttest (POST)		.97	.64	-.43	.03	-.33	.07		.98	.61	-.39	.05	-.33	.01
Pretest (PRE)	.93		.64	-.44	.01	-.34	.08	.92		.61	-.40	.05	-.34	.00
Socio-Cultural Advantage Factor (SCAF)	.52	.53		-.34	-.08	-.29	.01	.46	.48		-.36	-.03	-.30	-.11
CE Status (CE)	-.29	-.31	-.31		-.09	.45	-.04	-.26	-.29	-.30		-.07	.44	-.01
Hours of Regular Instruction (HR)	.10	.08	-.01	-.09		-.43	-.33	.10	.10	.04	-.16		-.40	-.31
Hours of Special Instruction (HS)	-.25	-.27	-.24	.35	-.47		-.04	-.23	-.25	-.24	.38	-.40		.02
Hours of Tutor/Independent Work (HI)	.01	.02	.01	.01	-.55	.03		.02	.02	-.01	.04	-.61	.03	

[*] POST = Posttest achievement factor based on at- and below-level posttest scores; PRE = pretest achievement factor based on at- and below-level pretest scores; SCAF = Socio-Cultural Advantage Factor based on race/ethnicity (1 = white; 0 = otherwise), participation in free- or reduced-price meals (1 = participant; 0 = otherwise), and mother's educational attainment (1 = high school graduate or above; 0 = otherwise); CE = selection for CE services in 1976-77 school year (1 = CE students; 0 = Non-CE students); HR = yearly hours of instructional services received from regular classroom teachers in groups of 7 or more; HS = yearly hours of instructional services received from special teachers or from classroom teachers in groups of 1-6, and assistance from paid aides; HI = yearly hours working with tutors or independently. All observed variables except those associated with the Socio-Cultural Advantage Factors are obtained for reading and math, separately.

Table C1-8

Modifications of the Basic Model in Order to Overcome Problems of Inadmissible LISREL Estimates in the ANCOVA for Reading and Math Achievement of CE Students and Non-CE Students Judged as Needing CE*

Grade	Constraints Imposed Because the Original Model Yields Inadmissible Estimates for Some Parameters*
Model for Reading	
1	Residual variance for latent variable 'POST' invariant over groups
2	Residual variance for latent variable 'POST' invariant over groups
3	Error variance for observed below-level pretest invariant over groups
4	None required
5	None required
6	Error variance for observed below-level pretest invariant over groups
Model for Math	
1	None required
2	None required
3	Uncorrelated errors between at-level pretest and posttest for all groups
4	None required
5	Error variance for observed below-level pretest invariant over groups
6	None required

---

[*] Please refer to the text for a description of the basic model. If any inadmissible LISREL estimates (e.g., negative error variance, negative residual variance, or correlations with magnitude exceeding 1.0) were obtained, the model was modified by adding the constraints summarized in this table so as to render the estimates admissible. 'POST' is the latent variable for posttest achievement.

Table C1-9

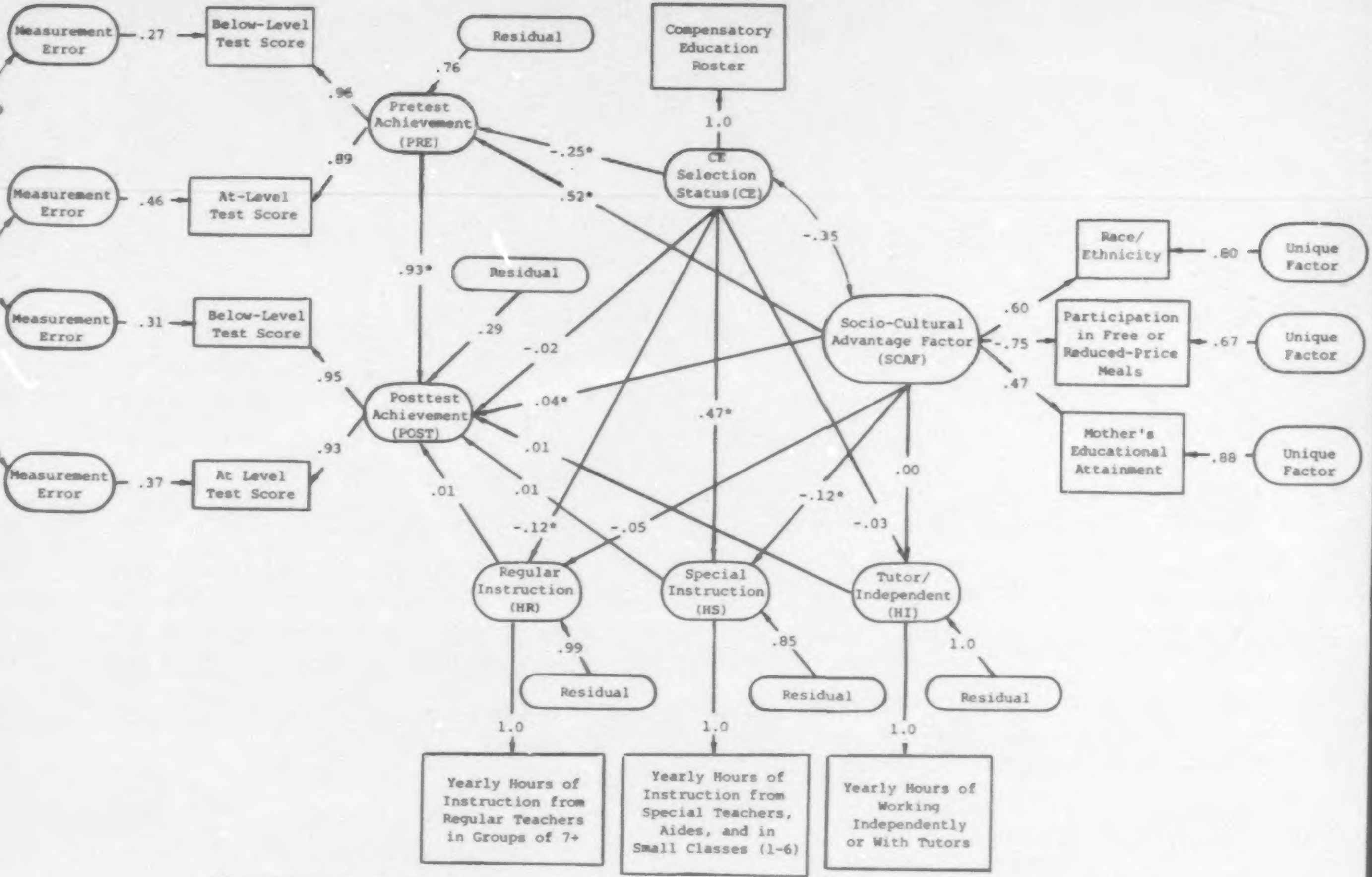
Within-Group Reliability for Reading and Math Pretests as Estimated from the Measurement Model in the ANCOVA with Latent Variables*

Grade	Pretest Level	Student Group**				
		TI/TI	OCE/TI	OCE/OCE	Needy NCE/CE	Needy NCE/NCE
Reading	Tests					
1	Below	.61	.63	.65	.56	.68
	At	.15	.18	.18	.14	.18
2	Below	.59	.77	.62	.57	.59
	At	.63	.77	.60	.58	.62
3	Below	.89	.94	.92	.89	.88
	At	.43	.52	.43	.38	.35
4	Below	.77	.90	.87	.84	.89
	At	.47	.67	.65	.53	.48
5	Below	.79	.89	.87	.81	.82
	At	.62	.82	.69	.71	.73
6	Below	.81	.89	.83	.84	.83
	At	.55	.71	.56	.58	.55
Math	Tests					
1	Below	.77	.75	.70	.61	.50
	At	.33	.38	.27	.22	.17
2	Below	.66	.79	.80	.68	.59
	At	.66	.76	.70	.65	.62
3	Below	.69	.85	.77	.70	.69
	At	.55	.65	.69	.57	.49
4	Below	.75	.92	.88	.75	.74
	At	.48	.57	.61	.47	.43
5	Below	.77	.87	.83	.79	.78
	At	.63	.71	.67	.63	.65
6	Below	.68	.79	.49	.70	.60
	At	.49	.63	.42	.51	.47

---

[*] The estimates are computed on the basis of the results for the basic model (Model A), see the text for a description of the model.

[**] TI/TI = Title I students in Title I schools; OCE/TI = Other-CE students in Title I schools; OCE/OCE = Other-CE students in Other-CE schools; Needy NCE/CE = Non-CE students in CE schools who are judged as needing CE; Needy NCE/NCE = Non-CE students in Non-CE schools who are judged as needing CE.

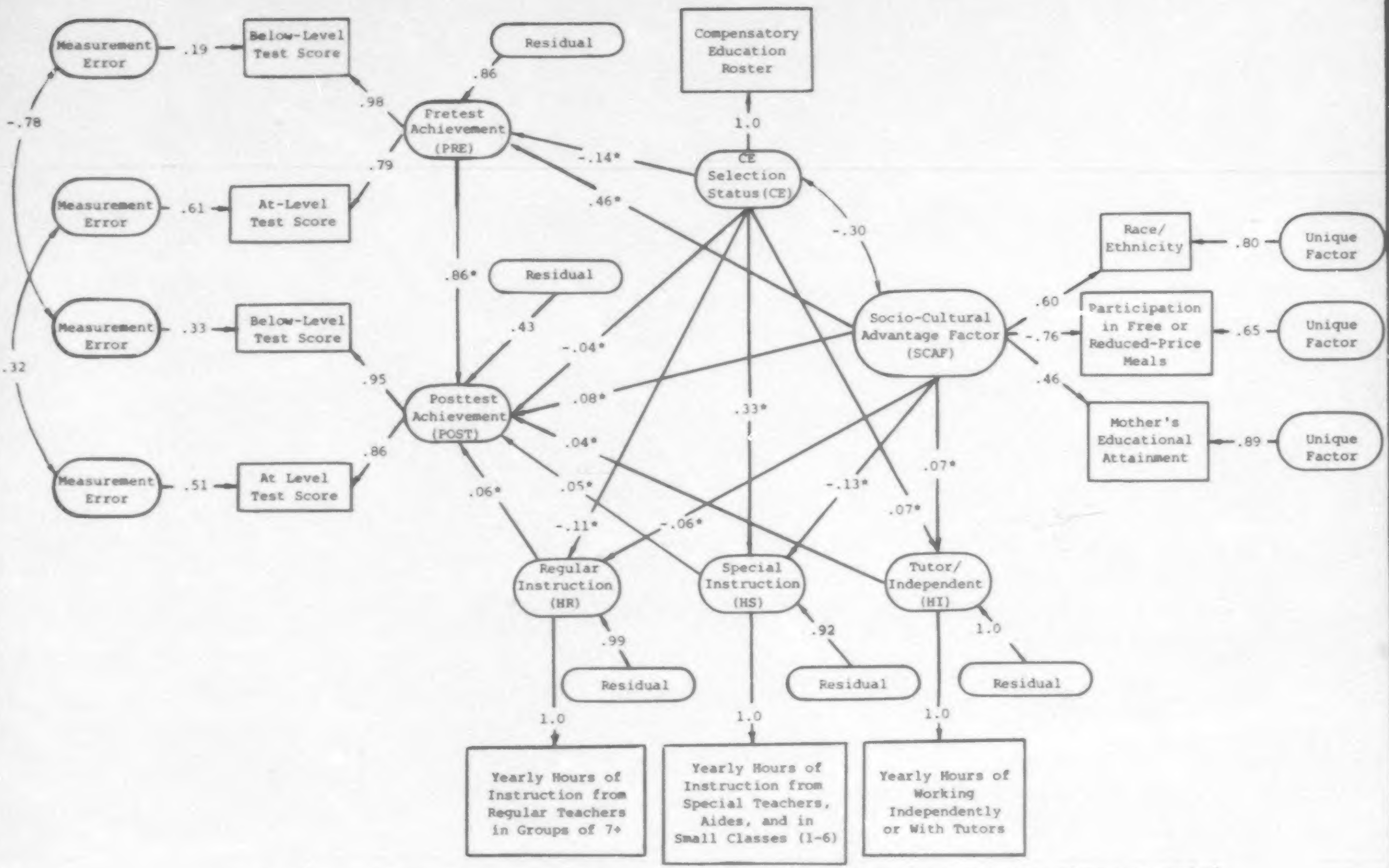

Measurement Error
.27
Below-Level Test Score
Residual
.76
Compensatory Education Roster
-.09
.96
Pretest Achievement (PRE)
1.0
.89
-.25*
CE Selection Status (CE)
Measurement Error
.46
At-Level Test Score
.52*
-.35
Race/ Ethnicity
.80
Unique Factor
.93*
Residual
Measurement Error
.31
Below-Level Test Score
.29
-.02
.60
Socio-Cultural Advantage Factor (SCAF)
-.75
Participation in Free or Reduced-Price Meals
.67
Unique Factor
.24
.95
.47
Posttest Achievement (POST)
.04*
.47*
Mother's Educational Attainment
.88
Unique Factor
.93
.01
.00
Measurement Error
.37
At Level Test Score
.01
.01
-.12*
-.12*
-.05
-.03
Regular Instruction (HR)
Special Instruction (HS)
Tutor/ Independent (HI)
.99
.85
1.0
Residual
Residual
Residual
1.0
1.0
1.0
Yearly Hours of Instruction from Regular Teachers in Groups of 7+
Yearly Hours of Instruction from Special Teachers, Aides, and in Small Classes (1-6)
Yearly Hours of Working Independently or With Tutors

(The model applies to data for grades 3 through 6. For grades 1 and 2, the two correlations between measurement errors for test scores are replaced with a single correlation between the measurement errors for at-level pretest and below-level posttest scores)

Figure C1-1

Estimated Coefficients (Standardized for all Observed and Latent Variables) of the Path Model for Reading Achievement in Grade 4

*Regression Coefficient in the Structural Model is Significant at the .01 level.


Measurement Error
.19
Below-Level Test Score
Residual
.86
Compensatory Education Roster
-.78
.98
Pretest Achievement (PRE)
1.0
-.14*
CE Selection Status(CE)
.79
Measurement Error
.61
At-Level Test Score
.46*
-.30
Race/ Ethnicity
.80
Unique Factor
.86*
Residual
.60
Participation in Free or Reduced-Price Meals
Measurement Error
.33
Below-Level Test Score
.43
Socio-Cultural Advantage Factor (SCAF)
-.76
.65
Unique Factor
-.04*
.32
.95
.46
.08*
.33*
Posttest Achievement (POST)
Mother's Educational Attainment
.89
Unique Factor
.04*
.86
.07*
Measurement Error
.51
At Level Test Score
.06*
.05*
-.13*
.07*
-.11*
-.06*
Regular Instruction (HR)
Special Instruction (HS)
Tutor/ Independent (HI)
.99
.92
1.0
Residual
Residual
Residual
1.0
1.0
1.0
Yearly Hours of Instruction from Regular Teachers in Groups of 7+
Yearly Hours of Instruction from Special Teachers, Aides, and in Small Classes (1-6)
Yearly Hours of Working Independently or With Tutors

(The model applies to data for grades 3 through 6. For grades 1 and 2, the two correlations between measurement errors for test scores are replaced with a single correlation between the measurement errors for at-level pretest and below-level posttest scores)

Figure C1-2

Estimated Coefficients (Standardized for all Observed and Latent Variables) of the Path Model for Math Achievement in Grade 4

*Regression Coefficient in the Structural Model is Significant at the .01 level.

APPENDIX C2

MATHEMATICAL FORMULATIONS OF STRUCTURAL-RELATION MODELS EMPLOYED IN CHAPTER 3

This Appendix provides the mathematical formulations of the models employed to examine the roles of CE and instructional services in effecting achievement growth. The first model, illustrated in Figure 3-3, is a general path model that describes the interrelationships among achievement, CE status, socio-background, and receipt of instructional services. The second model, illustrated in Figure 3-4, is an ANCOVA model with latent variables for comparisons of achievement growth among five groups of students (Title I students, Other-CE students in Title I schools, Other-CE students in Other-CE schools, Non-CE students attending CE schools and judged as needing CE, Non-CE students judged as needing CE but attending Non-CE schools).

A GENERAL PATH MODEL FOR READING AND MATH ACHIEVEMENT

As depicted in Figure 3-3, the model consists of two parts: the measurement model that describes the relationship between latent variables (or hypothetical constructs) and their respective observed indicators; and the linear structural relations model that stipulates the direct and indirect relationships between latent variables.

The Measurement Model. Following similar notations in Jöreskog and Sörbom (1978), the relationships of the observed variables ($\underset{\sim}{y}$ and $\underset{\sim}{x}$) to the latent dependent and independent variables ($\underset{\sim}{\eta}$ and $\underset{\sim}{\xi}$, respectively) are represented by:

$$\underset{\sim}{y} = \underset{\sim}{\Lambda}_y \underset{\sim}{\eta} + \underset{\sim}{\varepsilon} \quad , \quad \text{where} \quad \Xi(\underset{\sim}{\varepsilon}) = \underset{\sim}{0}, \quad \Xi(\underset{\sim\sim}{\eta\varepsilon'}) = \underset{\sim}{0} \qquad (C2.1) \quad ;$$

and

$$\underset{\sim}{x} = \underset{\sim}{\Lambda}_x \underset{\sim}{\xi} + \underset{\sim}{\delta} \quad , \quad \text{where} \quad \Xi(\underset{\sim}{\delta}) = \underset{\sim}{0} \quad \Xi(\underset{\sim\sim}{\xi\delta'}) = \underset{\sim}{0} \qquad (C2.2) \quad .$$

The matrices $\underset{\sim}{\Lambda}_y$ and $\underset{\sim}{\Lambda}_x$ contain regression coefficients of the observed indicators on the latent variables (in factor analysis, these coefficients are commonly known as factor loadings). The vectors $\underset{\sim}{\varepsilon}$ and $\underset{\sim}{\delta}$ are called errors of measurement (or unique factors in the terminology of factor analysis). These error variables may be correlated among themselves, and their covariance matrices are denoted as $\underset{\sim}{\Theta}_\varepsilon$ and $\underset{\sim}{\Theta}_\delta$, respectively. The covariance matrices of $\underset{\sim}{\eta}$ and $\underset{\sim}{\xi}$ are denoted as $\underset{\sim}{\Phi}_{\eta\eta}$ and $\underset{\sim}{\Phi}_{\xi\xi}$, respectively. Thus equations (C2.1) and (C2.2) imply that

$$\underset{\sim}{\Sigma}_{yy} = \underset{\sim}{\Lambda}_y \underset{\sim}{\Phi}_{\eta\eta} \underset{\sim}{\Lambda}_y' + \underset{\sim}{\Theta}_\varepsilon \qquad \text{(C2.3)} \quad ,$$

$$\underset{\sim}{\Sigma}_{xx} = \underset{\sim}{\Lambda}_x \underset{\sim}{\Phi}_{\xi\xi} \underset{\sim}{\Lambda}_x' + \underset{\sim}{\Theta}_\delta \qquad \text{(C2.4)} \quad ,$$

and

$$\underset{\sim}{\Sigma}_{yx} = \underset{\sim}{\Lambda}_y \underset{\sim}{\Phi}_{\eta\xi} \underset{\sim}{\Lambda}_x' \qquad \text{(C2.5)} \quad .$$

In the present analysis, the vector $\underset{\sim}{y}$ contains seven observed variables:

y_1 = Below-level posttest scores ;

y_2 = At-level posttest scores ;

y_3 = Below-level pretest scores ;

y_4 = At-level pretest scores ;

y_5 = Yearly hours of instructional services received from classroom teachers in groups of 7 or more students;

y_6 = Yearly hours of instructional services received from classroom teachers in groups of 1-6 students, or from special teaching staff;

and y_7 = Yearly hours working with tutor or independently.

The vector $\underset{\sim}{x}$ contains four observed variables:

x_1 = CE status (CE students versus Non-CE students);

x_2 = Race/ethnicity (caucasian/white versus non-caucasian/white);

x_3 = Participation in free or reduced-price meals (participant versus non-participant);

and x_4 = Mother's educational attainment (high school graduate versus non-graduate).

There are five latent variables in $\underset{\sim}{\eta}$ and two in $\underset{\sim}{\xi}$:

η_1 = Posttest achievement with y_1 and y_2 as indicators;

η_2 = Pretest achievement with y_3 and y_4 as indicators;

η_3 = Amount of regular instruction with y_5 as a single indicator;

η_4 = Amount of special instruction with y_6 as a single indicator;

η_5 = Amount of tutor/independent work with y_7 as a single indicator;

and ξ_1 = CE status with x_1 as a single indicator;

ξ_2 = Socio-cultural advantage factor with x_2, x_3, and x_4 as indicators.

Having a single indicator, the three latent variables for instructional services and that for CE status are in effect equivalent to their respective observed variables.

Accordingly, eqs. (C2.1) and (C2.2) for the model exhibited in Figure 3-3 can be explicitly written as:

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \\ y_6 \\ y_7 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ \lambda_1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & \lambda_2 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \\ \eta_5 \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \\ \varepsilon_7 \end{bmatrix} ;$$

and

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & \lambda_3 \\ 0 & \lambda_4 \end{bmatrix} \cdot \begin{bmatrix} \xi_1 \\ \xi_2 \end{bmatrix} + \begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \end{bmatrix} ,$$

respectively. Note that some elements in the matrices $\underset{\sim}{\Lambda}_y$ and $\underset{\sim}{\Lambda}_x$ assume fixed values of 1 in order for the model to be identified.

The diagonal elements ($\sigma^2_{\varepsilon_i}$ and $\sigma^2_{\delta_i}$) of the matrices $\underset{\sim}{\Theta}_\varepsilon$ and $\underset{\sim}{\Theta}_\delta$ in eqs. (C2.3) and (C2.4) are non-negative. Because y_5, y_6, y_7, and x_1 have single indicators, the error variances for these variables ($\sigma^2_{\varepsilon_5}$, $\sigma^2_{\varepsilon_6}$, $\sigma^2_{\varepsilon_7}$, and $\sigma^2_{\delta_1}$) are fixed to be zero. The off-diagonal elements ($\sigma_{\varepsilon_i \varepsilon_j}$ and $\sigma_{\delta_i \delta_j}$) of these matrices are zero with the following exceptions:

$\sigma_{\varepsilon_1 \varepsilon_3} \neq 0$ and $\sigma_{\varepsilon_2 \varepsilon_4} \neq 0$ for grades 3 through 6;

$\sigma_{\varepsilon_1 \varepsilon_4} \neq 0$ for grades 1 and 2.

The non-zero covariances between the error variables are postulated when test scores of the same level are involved.

The Structural Relation Model. The relationship between the latent dependent and independent variables, $\underset{\sim}{\eta}$ and $\underset{\sim}{\xi}$, is represented by:

$$\underset{\sim}{B}\,\underset{\sim}{\eta} = \underset{\sim}{\Gamma}\,\underset{\sim}{\xi} + \underset{\sim}{\zeta} \qquad \text{(C2.6)}$$

where $\Xi(\underset{\sim}{\zeta}) = \underset{\sim}{0}$, $\Xi(\underset{\sim}{\xi}\underset{\sim}{\zeta}') = \underset{\sim}{0}$, and $\underset{\sim}{B}$ is non-singular.

The matrices $\underset{\sim}{B}$ and $\underset{\sim}{\Gamma}$ contain regression coefficients,and $\underset{\sim}{\zeta}$ is a vector of residuals with a covariance matrix $\underset{\sim}{\Psi}$. It follows from eq. (C2.6) that

$$\underset{\sim}{\Phi}_{\eta\eta} = \underset{\sim}{B}^{-1}(\underset{\sim}{\Gamma}\,\underset{\sim}{\Phi}_{\xi\xi}\,\underset{\sim}{\Gamma}' + \underset{\sim}{\Psi})\,\underset{\sim}{B}^{-1'} \qquad \text{(C2.7)} \;,$$

and

$$\underset{\sim}{\Phi}_{\eta\xi} = \underset{\sim}{B}^{-1}\,\underset{\sim}{\Gamma}\,\underset{\sim}{\Phi}_{\xi\xi} \qquad \text{(C2.8)} \;.$$

For the present analysis, eq. (C2.6) can be explicitly written as:

$$\begin{bmatrix} 1 & -\beta_{12} & -\beta_{13} & -\beta_{14} & -\beta_{15} \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \\ \eta_5 \end{bmatrix} = \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \\ \gamma_{31} & \gamma_{32} \\ \gamma_{41} & \gamma_{42} \\ \gamma_{51} & \gamma_{52} \end{bmatrix} \begin{bmatrix} \xi_1 \\ \xi_2 \end{bmatrix} + \begin{bmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \\ \zeta_4 \\ \zeta_5 \end{bmatrix}$$

where the residuals $(\underset{\sim}{\zeta})$ are assumed to be uncorrelated (i.e., $\underset{\sim}{\Psi}$ is diagonal).

In terms of eqs. (C2.3) to (C2.8), the covariance matrix $\underset{\sim}{\Sigma}$ of the 11 observed variables ($\underset{\sim}{y}$ and $\underset{\sim}{x}$) can be expressed as a function of the unknown parameters in the path model:

$$\underset{\sim}{\Sigma} = \begin{bmatrix} \underset{\sim}{\Sigma}_{yy} & \underset{\sim}{\Sigma}_{yx} \\ \underset{\sim}{\Sigma}_{xy} & \underset{\sim}{\Sigma}_{xx} \end{bmatrix} = \begin{bmatrix} \underset{\sim}{\Lambda}_y\,\underset{\sim}{B}^{-1}(\underset{\sim}{\Gamma}\,\underset{\sim}{\Phi}_{\xi\xi}\,\underset{\sim}{\Gamma}' + \underset{\sim}{\Psi})\,\underset{\sim}{B}^{-1'}\,\underset{\sim}{\Lambda}_y' + \underset{\sim}{\Theta}_\varepsilon & \underset{\sim}{\Lambda}_y\underset{\sim}{B}^{-1}\underset{\sim}{\Gamma}\,\underset{\sim}{\Phi}_{\xi\xi}\,\underset{\sim}{\Lambda}_x' \\ \underset{\sim}{\Lambda}_x\,\underset{\sim}{\Phi}_{\xi\xi}\,\underset{\sim}{\Gamma}'\underset{\sim}{B}^{-1'}\,\underset{\sim}{\Lambda}_y' & \underset{\sim}{\Lambda}_x\,\underset{\sim}{\Phi}_{\xi\xi}\,\underset{\sim}{\Lambda}_x' + \underset{\sim}{\Theta}_\delta \end{bmatrix} \text{(C2.9)} \;.$$

Maximum likelihood estimates of the parameters in the right-hand side of eq. (C2.9) are obtained with the LISREL IV program, which employs a gradient-based search algorithm to minimize the function F (negatively related to the likelihood function of $\underset{\sim}{\Sigma}$) :

$$F = \ln|\underset{\sim}{\Sigma}| + \mathrm{tr}\,(\underset{\sim}{\Sigma}^{-1}\underset{\sim}{S}) - \ln|\underset{\sim}{S}| - (p+q) \quad , \qquad \text{(C2.10)}$$

where p and q are the number of variables in $\underset{\sim}{y}$ and $\underset{\sim}{x}$, respectively, and $\underset{\sim}{S}$ is the unbiased sample estimate of $\underset{\sim}{\Sigma}$. Upon convergence, the information matrix is used to compute standard errors of the parameter estimates.

AN ANCOVA MODEL WITH LATENT VARIABLES FOR THE ACHIEVEMENT OF CE AND COMPARISON NON-CE STUDENTS

In general, LISREL models are employed to analyze deviation scores (i.e., with covariance matrix as input data) and therefore do not deal with mean differences when the models are applied to data for several groups simultaneously. Although group differences may be examined in terms of path coefficients for dummy grouping variables in such models, the ANCOVA model with latent variables ('true score' ANCOVA) presented in Sörbom (1978) allows explicit estimation of means for latent variables and thus direct comparisons between group means can be made. As in ordinary ANCOVA, the validity of the assumption of parallel within-group regression surfaces that characterize the relation between latent variables can be assessed first. Then,if it holds, group effects may be compared in terms of adjusted means for the latent dependent variables.

The LISREL IV program was adapted to solve the estimation problem of the 'true score' ANCOVA model. In essence, a variable having a constant value of 1.0 is incorporated into the LISREL model, and the moment matrices for several groups are analyzed simultaneously to obtain estimates of means for latent variables as well as the regression coefficients.

Again, the model includes two parts: the Measurement Model and the Structural Relation Model.

The Measurement Model. The basic model is similar to that of eq. (C2.1) with additional parameters for the means. The same observed variables explained earlier in the path model are used. However, the dummy-coded variable for CE status is no longer needed because students are now grouped according to their CE statuses and data for separate groups are analyzed simultaneously. The same measurement model is applied to each group. Because the present model can be presented most conveniently as a special case of the LISREL model where there are no '$\underset{\sim}{x}$' variables (i.e., treating all variables involved as one set), the model for each group g is described below in a single equation. For simplicity, the superscript (g) for the variables and parameters is omitted.

$$\begin{bmatrix} \underset{\sim}{y} \\ \underset{\sim}{x} \\ 1 \end{bmatrix} = \begin{bmatrix} \underset{\sim}{\Lambda}_y & \underset{\sim}{0} & \underset{\sim}{\mu}_y \\ \underset{\sim}{0} & \underset{\sim}{\Lambda}_x & \underset{\sim}{\mu}_x \\ 0 & \underset{\sim}{0} & 1 \end{bmatrix} \begin{bmatrix} \eta \\ \underset{\sim}{\xi} \\ 1 \end{bmatrix} + \begin{bmatrix} \underset{\sim}{\varepsilon}_y \\ \underset{\sim}{\varepsilon}_x \\ 0 \end{bmatrix}$$

$$\underset{\sim}{w} \quad = \quad \underset{\sim}{\Lambda} \quad \underset{\sim}{\omega} \quad + \quad \underset{\sim}{\varepsilon} \quad , \qquad \text{(C2.11)}$$

where $\Xi\,(\eta) = \theta_\eta$, $\Xi\,(\underset{\sim}{\xi}) = \underset{\sim}{\theta}_\xi$, $\Xi\,(\underset{\sim}{\varepsilon}) = \underset{\sim}{0}$, and $\Xi\,(\underset{\sim\sim}{\omega\varepsilon'}) = \underset{\sim}{0}$.

The notations $\underset{\sim}{y}$ and $\underset{\sim}{x}$ are used to keep the disti[illegible]on between latent dependent and independent variables in the ANCOVA setup.

In the present analysis (see Figure 3-4 for illustration), $\underset{\sim}{y}$ contains two indicators (y_1 and y_2) for posttest achievement (η). The vector $\underset{\sim}{x}$ contains two indicators (x_1 and x_2) for pretest achievement (ξ_1), three indicators (x_3, x_4, and x_5) for the socio-cultural advantage factor (ξ_2), and one indicator (x_6, x_7, and x_8, respectively) for each of the three latent variables for amount of instruction received (ξ_3, ξ_4, and ξ_5, respectively). Detailed information on these indicators can be found in the preceding section (see pages C2-2 to C2-3). Thus, eq. (C2.11) for the analysis can be written in an expanded form as:

$$\begin{bmatrix} y_1 \\ y_2 \\ x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \\ x_6 \\ x_7 \\ x_8 \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & \mu_1 \\ \lambda_1 & 0 & 0 & 0 & 0 & 0 & \mu_2 \\ 0 & 1 & 0 & 0 & 0 & 0 & \mu_3 \\ 0 & \lambda_2 & 0 & 0 & 0 & 0 & \mu_4 \\ 0 & C & 1 & 0 & 0 & 0 & \mu_5 \\ 0 & 0 & \lambda_3 & 0 & 0 & 0 & \mu_6 \\ 0 & 0 & \lambda_4 & 0 & 0 & 0 & \mu_7 \\ 0 & 0 & 0 & 1 & 0 & 0 & \mu_8 \\ 0 & 0 & 0 & 0 & 1 & 0 & \mu_9 \\ 0 & 0 & 0 & 0 & 0 & 1 & \mu_{10} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \eta \\ \xi_1 \\ \xi_2 \\ \xi_3 \\ \xi_4 \\ \xi_5 \\ 1 \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \\ \varepsilon_7 \\ \varepsilon_8 \\ \varepsilon_9 \\ \varepsilon_{10} \\ 0 \end{bmatrix}$$

The parameters λ's and μ's are constrained to be invariant over groups. The covariance matrix ($\underset{\sim}{\Theta}_{\varepsilon}$) for the errors $\underset{\sim}{\varepsilon}$ are allowed to vary with the groups, but the last diagonal element is always fixed to be zero because the variable '1' is in fact a constant. Furthermore, the variances for ε_8, ε_9, and ε_{10} are also fixed to be zero as the three service variables do not have multiple measures. In addition, correlated errors are assumed between test scores that involve the same test level (i.e., for grades 1 and 2, $\sigma_{\varepsilon_1\varepsilon_4}$ is free; and $\sigma_{\varepsilon_1\varepsilon_3}$ and $\sigma_{\varepsilon_2\varepsilon_4}$ are free for grades 3 to 6).

The Structural Relation Model. This part of the model specifies an ANCOVA paradigm for the latent variables. Again, the same model is applied to the five analysis groups simultaneously, and is expressed by the equation below (the superscript (g) is omitted from the equation):

$$\begin{bmatrix} \eta \\ \xi \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & -\underset{\sim}{\gamma}' & -\alpha \\ \underset{\sim}{0} & \underset{\sim}{I} & -\underset{\sim}{\theta}_{\xi} \\ 0 & \underset{\sim}{0}' & 1 \end{bmatrix}^{-1} \begin{bmatrix} \zeta_{\eta} \\ \underset{\sim}{\zeta}_{\xi} \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & \gamma' & \theta_{\eta} \\ \underset{\sim}{0} & \underset{\sim}{I} & \underset{\sim}{\theta}_{\xi} \\ 0 & \underset{\sim}{0}' & 1 \end{bmatrix} \begin{bmatrix} \zeta_{\eta} \\ \underset{\sim}{\zeta}_{\xi} \\ 1 \end{bmatrix}$$

$$\underset{\sim}{\omega} = \underset{\sim}{B}^{-1} \underset{\sim}{\zeta} = \underset{\sim}{B}^{-1} \underset{\sim}{\zeta} \quad , \qquad \text{(C2.12)}$$

where $\Xi\,(\zeta_{\eta}) = 0$, $\Xi\,(\underset{\sim}{\zeta}_{\xi}) = \underset{\sim}{0}$, $\Xi\,(\zeta_{\eta}^2) = \psi$, $\Xi\,(\underset{\sim}{\zeta}_{\xi}\zeta_{\eta}) = \underset{\sim}{0}$, and $\Xi\,(\underset{\sim}{\zeta}_{\xi}\underset{\sim}{\zeta}_{\xi}') = \underset{\sim}{\Phi}_{\xi\xi}$.

Note that ζ_η is the residual for η regressed on $\boldsymbol{\xi}$, and $\boldsymbol{\zeta}_\xi$ expresses $\boldsymbol{\xi}$ in deviation form. The residual variance of η ($\mathrm{var}(\eta|\boldsymbol{\xi})$) is ψ, and the variance-covariance matrix of the latent independent variables $\boldsymbol{\xi}$ is $\boldsymbol{\Phi}_{\xi\xi}$.

The first row in the equation system (C2.12) represents the ANCOVA formulation for η with $\boldsymbol{\xi}$ as the vector of covariates. That is ,

$$\eta = \theta_\eta + \boldsymbol{\gamma}'\boldsymbol{\zeta}_\xi + \zeta_\eta = \alpha + \boldsymbol{\gamma}'\boldsymbol{\xi} + \zeta_\eta \, , \qquad \text{(C2.13)}$$

where $\alpha = \theta_\eta - \boldsymbol{\gamma}'\boldsymbol{\theta}_\xi$.

The second, third, and fourth equations in (C2.12) transform the covariates into deviations ($\boldsymbol{\zeta}_\xi$) : $\boldsymbol{\zeta}_\xi = \boldsymbol{\xi} - \boldsymbol{\theta}_\xi$. It may be remarked that the model in (C2.13) is more general than the ordinary ANCOVA because it allows the residual variance ψ to differ among groups. The regression coefficients $\boldsymbol{\gamma}$ may be constrained to be invariant over groups to test the assumption of parallel regression surfaces.

It follows from eq. (C2.11) and (C2.12) that the moment matrix of $w = (y' \; x' \; 1)'$ is

$$\boldsymbol{M}_w = \boldsymbol{\Lambda} \boldsymbol{M}_\omega \boldsymbol{\Lambda}' + \boldsymbol{\Theta}_\varepsilon \, , \qquad \text{(C2.14)}$$

where $\boldsymbol{M}_\omega = \boldsymbol{B}^{-1} [\Xi(\boldsymbol{\zeta}\boldsymbol{\zeta}')] \boldsymbol{B}^{-1'} = \boldsymbol{B}^{-1} \begin{bmatrix} \psi & & \\ & \boldsymbol{\Phi}_{\xi\xi} & \\ & & 1 \end{bmatrix} \boldsymbol{B}^{-1'}$.

It can be shown from eq. (C2.13) that the moment for the latent dependent variable η is

$$M_\eta = \theta_\eta^2 + \boldsymbol{\gamma}'\boldsymbol{\Phi}_{\xi\xi}\boldsymbol{\gamma} + \psi \quad .$$

Therefore, it is found that

$$\psi = M_\eta - \theta_\eta^2 - \boldsymbol{\gamma}'\boldsymbol{\Phi}_{\xi\xi}\boldsymbol{\gamma} = \mathrm{var}(\eta) - \boldsymbol{\gamma}'\boldsymbol{\Phi}_{\xi\xi}\boldsymbol{\gamma} \quad ,$$

as in the case of ordinary regression analysis.

The maximum likelihood estimates of the unknown parameters in eqs. (C2.11) and (C2.12) are obtained with the LISREL IV program by substituting $\underset{\sim}{M}_w$ and $\underset{\sim}{M}_\omega$ for $\underset{\sim}{S}$ and $\underset{\sim}{\Sigma}$, respectively, in eq. (C2.10), and minimizing the function F. The matrix $\underset{\sim}{M}_w$ is the sample estimate of the raw moments of the observed variables $\underset{\sim}{w}$. Because of the inclusion of the constant 1.0 in the vector $\underset{\sim}{w}$, the last row (and column) in this matrix contain(s) the means of the variables $\underset{\sim}{y}$ and $\underset{\sim}{x}$.

APPENDIX D

SUPPLEMENTARY TABLES AND FIGURES FOR CHAPTER 4

Table D-1

Linear Regressions of Reading and Math Achievement Gains on Service Costs for the Sample of All CE Students*

Grade	Range and Mean of Service Cost			Sign of Regression Coefficients or Critical Amount of Effort for Four Measures of Gain**			
	Min.	Max.	Mean	Z-Score Gain	Residual Gain A	Residual Gain B	VSS Gain
Reading Achievement							
1	66	1,426	423	-	+	402	-
2	56	1,448	420	+	-	-	-
3	77	1,596	383	140	830	+	+, 627
4	72	1,072	363	355	+	357	458, 430
5	55	1,112	320	+	+	-	+, 130
6	33	1,079	298	267	+	189	312, 250
Math Achievement							
1	41	733	184	186	+	157	+
2	36	947	184	-	-	-	-
3	52	734	213	-	+	-	-
4	59	956	239	277	340	534	243, 272
5	42	935	235	129	89	231	+, 76
6	49	1,011	206	166	124	137	62, 100

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[*] Four measures of achievement gains are used: z-score gain = posttest z-score minus pretest z-score; residual gain A = observed posttest score minus predicted posttest score based on a prediction model estimated with data for students in non-CE schools; residual gain B - similar to residual gain A, but the prediction model is estimated with data for non-CE students in CE schools; and VSS gain - posttest VSS minus pretest VSS. Costs for services are measured in Standard-Resource-Dollar units on the basis of a resource-cost model developed in Technical Report 6.

[**] '+' or '-' in the entries of the table represent the sign of the regression coefficient of gain on cost. When the regression is positive and it is possible to obtain a level of effort within the range of costs in the sample of CE students such that reduction in their achievement deficit will be attained, the '+' entry is replaced with the numerical value for this critical level of cost (see the text for details of how to find this value). Two such values may be obtained for VSS gains because two criteria are used for this measure of gain, based on the average gains for needy non-CE students in non-CE and CE schools, respectively.

Table D-2
Quadratic Regressions of Reading and Math Achievement Gains on Service Costs for the Sample of All CE Students*

Grade	Range of Costs Within Which Expected Gain Increases Monotonically With Cost for Four Measures of Gain**			
	Z-Score Gain	Residual Gain A	Residual Gain B	VSS Gain
Reading Achievement				
1	LT 517	LT 576	LT 643	LT 415
2	LT 580	LT 358	LT 469	LT 452
3	LT 658	LT 494	LT 545	LT 605
4	ALL	ALL	LT 707	LT 862
5	LT 698	LT 519	LT 138	LT 409
6	ALL	GT 295	ALL	GT 165
Math Achievement				
1	LT 341	LT 319	LT 310	LT 284
2	GT 308	GT 581	GT 670	GT 327
3	--	LT 343	LT 230	--
4	GT 75	GT 154	GT 203	GT 142
5	LT 731	LT 681	LT 614	ALL
6	ALL	ALL	ALL	ALL

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[*] See Table D-1 for explanations of measures of achievement gain and cost for services received.

[**] A value preceded by 'LT' indicates that for costs less than that value, gain increases with cost; while a value preceded by 'GT' indicates that, for costs greater than that value, gain increases with cost. '--' in the entry indicates that, within the range of actual costs for CE students, the relationship is negative, while 'ALL; indicates gain increases with cost over the whole range of actual costs for CE students.

Table D-3

Means and Standard Deviations of the Total Standard Resource-Dollar Costs for Instructional Services Received by CE Students*

Grade	Total Cost for Reading		Total Cost for Math	
	Mean	S.D.	Mean	S.D.
1	423	191	184	96
2	420	199	184	104
3	383	181	213	102
4	363	163	239	140
5	320	157	235	134
6	298	155	206	123

*These statistics were used to define levels of cost for reading and math services received.

Table D-4

Means and Corresponding Percentages (in Parentheses) of Yearly Hours of Reading Services Received per Instructional Setting for CE Students, by Eight Levels of the Total Standard-Resource-Dollar Costs for Reading Services at Each Grade

GRADE	Instructional Setting: Type of Instructors, Size of Group (or Materials Used)	Cost Levels Defined in Terms of Mean (M) and Standard Deviation (S) of the Distribution of Total Service Costs for CE Students in Each Grade - Each Level Covers the Costs that are Greater than the Lower Bound (L) but Less than or Equal to the Upper Bound (U) Given Below								All Reading CE Students
	L: U:	Lowest M - 1.5S	M - 1.5S M - 1.0S	M - 1.0S M - 0.5S	M - 0.5S M	M M + 0.5S	M + 0.5S M + 1.0S	M + 1.0S M + 1.5S	M + 1.5S Highest	
	Number of CE Students	19	297	552	535	398	254	154	205	2,414
	Classroom Teachers, 21 or more	35.0 (27)	30.3 (14)	38.4 (14)	32.3 (11)	37.3 (11)	31.7 (9)	19.7 (5)	21.1 (5)	32.5 (11)
	Classroom Teachers, 14-20	7.3 (6)	16.5 (8)	14.6 (6)	11.6 (4)	8.4 (2)	11.9 (3)	20.5 (6)	11.1 (3)	12.9 (4)
	Classroom Teachers, 7-13	30.1 (24)	45.8 (22)	63.5 (24)	70.1 (23)	72.2 (21)	72.5 (20)	39.7 (11)	65.7 (16)	63.7 (21)
	Classroom Teachers, 1-6	2.1 (2)	9.7 (5)	17.3 (6)	34.4 (11)	49.2 (14)	65.1 (18)	96.6 (27)	120.7 (29)	44.2 (14)
	Special Teachers, 7 or more	3.3 (3)	3.5 (2)	13.0 (5)	20.8 (7)	27.1 (8)	27.3 (7)	14.3 (4)	11.2 (3)	17.2 (6)
1	Special Teachers, 1-6	1.0 (1)	1.3 (1)	3.8 (1)	10.8 (4)	16.8 (5)	25.9 (7)	48.5 (13)	77.3 (19)	18.6 (6)
	Aides or Assistants, 1-10	19.8 (16)	31.1 (15)	27.7 (10)	30.7 (10)	28.2 (8)	27.4 (7)	17.2 (5)	8.7 (2)	26.5 (9)
	Tutor or Adult Volunteer, 1	0.7 (1)	3.7 (2)	3.4 (1)	3.7 (1)	4.9 (1)	4.4 (1)	4.1 (1)	1.3 (0)	3.7 (1)
	Independent, Programmed	3.8 (3)	19.7 (9)	8.2 (3)	11.4 (4)	13.4 (4)	15.5 (4)	8.5 (2)	9.5 (2)	12.0 (4)
	Independent, Non-Programmed	24.2 (19)	51.1 (24)	75.6 (28)	72.8 (24)	82.2 (24)	86.2 (23)	93.9 (26)	84.7 (21)	75.7 (25)
	Total Reading Services*	127.3	213.1	265.7	298.9	340.2	368.6	363.3	412.5	307.3
	Number of CE Students	46	310	590	664	516	305	167	216	2,814
	Classroom Teachers, 21 or more	33.5 (25)	24.6 (13)	29.5 (11)	31.7 (11)	40.0 (13)	35.6 (10)	20.0 (6)	15.1 (4)	30.5 (10)
	Classroom Teachers, 14-20	3.1 (2)	17.5 (9)	17.1 (7)	13.6 (5)	7.2 (2)	12.1 (4)	9.1 (3)	3.9 (1)	12.3 (4)
	Classroom Teachers, 7-13	12.[illegible] (9)	40.7 (21)	75.4 (29)	80.6 (27)	66.5 (21)	72.6 (21)	64.5 (18)	35.5 (9)	66.1 (22)
	Classroom Teachers, 1-6	2.3 (2)	6.9 (4)	11.1 (4)	23.3 (8)	42.7 (14)	57.2 (17)	70.4 (19)	127.9 (33)	36.7 (12)
	Special Teachers, 7 or more	5.8 (4)	6.4 (3)	10.9 (4)	15.8 (5)	21.3 (7)	22.9 (7)	34.2 (9)	26.9 (7)	17.3 (6)
2	Special Teachers, 1-6	0.0 (0)	1.2 (1)	6.3 (2)	14.7 (5)	22.8 (7)	31.3 (9)	48.3 (13)	78.4 (20)	21.4 (7)
	Aides or Assistants, 1-10	9.0 (7)	20.6 (11)	22.7 (9)	25.2 (9)	22.7 (7)	21.9 (6)	21.4 (6)	13.3 (3)	21.9 (7)
	Tutor or Adult Volunteer, 1	0.1 (0)	0.9 (0)	2.6 (1)	4.5 (2)	4.4 (1)	5.5 (2)	2.9 (1)	3.3 (1)	3.5 (1)
	Independent, Programmed	34.8 (26)	15.5 (8)	7.8 (3)	11.0 (4)	14.9 (5)	13.6 (4)	8.7 (2)	10.7 (3)	12.1 (4)
	Independent, Non-Programmed	30.[illegible] (23)	56.1 (29)	79.0 (30)	73.1 (25)	70.6 (23)	71.7 (21)	81.5 (23)	77.0 (20)	72.0 (24)
	Total Reading Services*	131.4	190.4	262.5	293.7	313.7	345.1	361.4	391.9	293.9
	Number of CE Students	21	325	606	539	423	278	186	214	2,592
	Classroom Teachers, 21 or more	43.1 (26)	25.3 (13)	36.4 (16)	29.8 (12)	34.0 (11)	38.0 (12)	46.8 (14)	16.7 (5)	32.6 (12)
	Classroom Teachers, 14-20	36.2 (22)	22.4 (12)	14.9 (6)	7.7 (3)	11.7 (4)	7.5 (2)	8.0 (2)	13.9 (4)	12.6 (5)
	Classroom Teachers, 7-13	19.3 (12)	39.2 (21)	47.2 (21)	57.5 (23)	64.3 (21)	57.4 (18)	57.1 (17)	24.0 (7)	50.8 (19)
	Classroom Teachers, 1-6	0.3 (0)	6.2 (3)	15.2 (7)	26.6 (10)	30.6 (10)	53.4 (17)	60.6 (18)	98.1 (29)	33.0 (12)
	Special Teachers, 7 or more	7.0 (4)	10.1 (5)	12.2 (5)	19.9 (8)	27.9 (9)	23.3 (7)	24.2 (7)	11.4 (3)	18.1 (7)
3	Special Teachers, 1-6	0.0 (0)	1.3 (1)	5.3 (2)	11.9 (5)	22.7 (8)	34.0 (11)	44.5 (13)	84.1 (25)	21.4 (8)
	Aides or Assistants, 1-10	5.3 (3)	17.7 (9)	25.9 (11)	21.3 (8)	20.7 (7)	18.6 (6)	22.0 (6)	17.4 (5)	21.1 (8)
	Tutor or Adult Volunteer, 1	0.0 (0)	0.8 (0)	2.7 (1)	1.8 (1)	2.4 (1)	3.0 (1)	4.5 (1)	1.1 (0)	2.2 (1)
	Independent, Programmed	6.4 (4)	8.0 (4)	5.5 (2)	9.0 (4)	10.0 (3)	11.5 (4)	15.1 (4)	17.3 (5)	9.6 (4)
	Independent, Non-Programmed	47.6 (29)	57.5 (31)	63.6 (28)	68.6 (27)	77.0 (26)	64.0 (21)	59.0 (17)	59.0 (17)	65.3 (24)
	Total Reading Services*	165.5	188.6	229.0	254.3	301.8	311.3	342.6	343.3	267.0
	Number of CE Students	66	266	408	430	372	247	182	159	2,130
	Classroom Teachers, 21 or more	60.4 (38)	47.1 (25)	23.2 (11)	27.2 (12)	25.6 (10)	24.6 (9)	34.9 (12)	25.8 (8)	29.9 (13)
	Classroom Teachers, 14-20	27.0 (17)	19.1 (10)	8.4 (4)	18.4 (8)	13.8 (5)	10.9 (4)	5.8 (2)	9.6 (3)	13.4 (6)
	Classroom Teachers, 7-13	0.9 (1)	20.3 (11)	50.6 (25)	49.1 (21)	56.7 (22)	50.9 (19)	40.4 (14)	34.3 (11)	44.0 (18)
	Classroom Teachers, 1-6	0.7 (0)	5.0 (3)	11.7 (6)	16.8 (7)	21.2 (8)	38.9 (15)	59.5 (21)	95.2 (30)	26.7 (11)
	Special Teachers, 7 or more	5.0 (3)	11.8 (6)	11.3 (6)	15.4 (7)	24.0 (9)	21.3 (8)	22.5 (8)	26.7 (8)	17.5 (7)
4	Special Teachers, 1-6	0.8 (1)	1.8 (1)	6.4 (3)	16.4 (7)	30.2 (12)	40.4 (15)	42.1 (15)	63.7 (20)	23.1 (10)
	Aides or Assistants, 1-10	5.0 (3)	15.7 (8)	19.6 (10)	16.1 (7)	12.0 (5)	10.3 (4)	11.0 (4)	6.6 (2)	13.9 (6)
	Tutor or Adult Volunteer, 1	0.0 (0)	1.8 (1)	1.8 (1)	2.0 (1)	1.4 (1)	1.7 (1)	1.7 (1)	3.9 (1)	1.8 (1)
	Independent, Programmed	6.[illegible] (4)	2.3 (1)	7.9 (4)	14.5 (6)	17.6 (7)	12.7 (5)	19.0 (7)	6.0 (2)	11.6 (5)
	Independent, Non-Programmed	5[illegible].4 (33)	61.3 (33)	64.1 (31)	59.3 (25)	52.8 (21)	54.4 (20)	51.1 (18)	43.5 (14)	56.7 (24)
	Total Reading Services*	160.0	186.2	205.3	235.7	255.5	266.6	288.8	315.8	238.9
	Number of CE Students	44	211	461	401	396	190	141	[illegible]60	2,004
	Classroom Teachers, 21 or more	77.6 (67)	57.7 (36)	40.3 (20)	42.3 (19)	32.3 (13)	25.6 (11)	26.0 (10)	22.7 (8)	33.0 (17)
	Classroom Teachers, 14-20	6.8 (6)	17.9 (11)	17.2 (9)	7.5 (3)	9.9 (4)	10.2 (4)	9.8 (4)	10.7 (4)	12.0 (5)
	Classroom Teachers, 7-13	0.8 (1)	14.3 (9)	39.4 (20)	43.1 (19)	56.3 (23)	40.5 (17)	38.9 (15)	19.1 (7)	38.4 (17)
	Classroom Teachers, 1-6	0.0 (0)	2.2 (1)	6.8 (3)	17.3 (8)	20.7 (8)	36.0 (15)	46.4 (17)	72.1 (25)	21.8 (10)
	Special Teachers, 7 or more	0.0 (0)	6.4 (4)	19.0 (10)	21.4 (9)	22.1 (9)	9.4 (4)	12.0 (4)	6.6 (2)	16.0 (7)
5	Special Teachers, 1-6	0.0 (0)	1.2 (1)	3.0 (2)	9.1 (4)	20.0 (8)	40.2 (17)	51.3 (19)	84.7 (30)	20.8 (9)
	Aides or Assistants, 1-10	1.3 (1)	11.2 (7)	12.3 (6)	16.0 (7)	12.2 (5)	10.9 (5)	16.9 (6)	12.2 (4)	12.9 (6)
	Tutor or Adult Volunteer, 1	0.0 (0)	0.3 (0)	1.8 (1)	2.7 (1)	2.5 (1)	1.6 (1)	1.5 (1)	2.9 (1)	2.0 (1)
	Independent, Programmed	0.3 (0)	13.4 (8)	13.0 (7)	8.8 (4)	13.6 (6)	15.0 (6)	17.2 (6)	10.1 (4)	12.3 (6)
	Independent, Non-Programmed	29.7 (25)	37.4 (23)	44.3 (22)	58.7 (26)	53.9 (22)	48.0 (20)	47.4 (18)	42.7 (15)	48.5 (22)
	Total Reading Services*	116.6	162.1	197.1	226.9	244.0	237.8	267.5	284.0	222.6
	Number of CE Students	31	244	428	448	328	237	122	178	2,016
	Classroom Teachers, 21 or more	42.3 (68)	55.5 (37)	31.1 (18)	29.4 (14)	25.3 (11)	30.6 (12)	28.1 (11)	15.7 (6)	31.3 (15)
	Classroom Teachers, 14-20	1.2 (2)	15.4 (10)	24.8 (14)	27.0 (13)	25.5 (11)	22.5 (9)	12.4 (5)	12.3 (4)	21.8 (10)
	Classroom Teachers, 7-13	2.4 (4)	17.2 (11)	30.4 (17)	37.1 (18)	38.8 (16)	31.6 (12)	37.9 (15)	36.2 (13)	32.3 (15)
	Classroom Teachers, 1-6	4.4 (7)	3.0 (2)	9.1 (5)	14.8 (7)	25.2 (10)	30.5 (12)	33.1 (13)	60.0 (21)	20.6 (10)
	Special Teachers, 7 or more	0.0 (0)	6.5 (4)	12.6 (7)	12.4 (6)	25.9 (11)	32.6 (13)	18.1 (7)	19.6 (7)	17.1 (8)
6	Special Teachers, 1-6	0.0 (0)	0.6 (0)	3.4 (2)	8.0 (4)	18.2 (8)	31.5 (12)	56.0 (22)	73.2 (26)	19.1 (9)
	Aides or Assistants, 1-10	0.0 (0)	3.2 (2)	10.1 (6)	15.7 (8)	11.7 (5)	13.9 (5)	13.5 (5)	8.9 (3)	11.2 (5)
	Tutor or Adult Volunteer, 1	0.0 (0)	0.8 (1)	1.1 (1)	3.8 (2)	0.6 (0)	2.3 (1)	2.9 (1)	1.1 (0)	1.8 (1)
	Independent, Programmed	0.6 (1)	9.6 (6)	16.4 (9)	13.3 (6)	15.5 (6)	13.2 (5)	8.3 (3)	16.2 (6)	13.6 (6)
	Independent, Non-Programmed	11.4 (18)	38.3 (25)	38.1 (22)	47.8 (23)	53.6 (22)	45.5 (18)	46.0 (18)	39.8 (14)	43.9 (21)
	Total Reading Services*	62.4	150.6	177.2	209.3	240.5	254.5	256.6	283.2	212.9

*The percentages are obtained as mean hours in each setting divided by mean total hours and then multiplied by 100. Discrepancies between the mean total hours of services and the sum of hours in the 10 settings, and discrepancies between the sum of the 10 percentages and 100 are due to rounding errors.

Table D-5

Means and Corresponding Percentages (in Parentheses) of Standard-Resource-Dollar Costs of Reading Services Received Per Instructional Setting for CE Students by Eight Levels of the Total Costs for Reading Services at Each Grade

Grade	Instructional Setting: Type of Instructors, Size of Group (or Materials Used)	Cost Levels Defined in Terms of Mean (M) and Standard Deviation (S) of the Distribution of Total Service Costs for CE Students in Each Grade - Each Level Covers the Costs that are Greater than the Lower Bound (L) but Less than or Equal to the Upper Bound (U) Given Below								All Reading CE Students
	L: U:	Lowest M - 1.5S	M - 1.5S M - 1.0S	M - 1.0S M - 0.5S	M - 0.5S M	M M + 0.5S	M + 0.5S M + 1.0S	M + 1.0S M + 1.5S	M + 1.5S Highest	
1	Number of CE Students	19	297	552	535	[illegible]	254	154	205	2,414
	Classroom Teachers, 21 or more	23.9 (21)	18.4 (9)	24.3 (9)	21.3 (6)	24.6 (5)	19.9 (4)	12.5 (2)	13.5 (2)	20.8 (5)
	Classroom Teachers, 14-20	7.3 (6)	15.3 (8)	14.2 (5)	11.2 (3)	9.2 (2)	11.6 (2)	18.3 (3)	9.9 (1)	12.4 (3)
	Classroom Teachers, 7-13	38.1 (34)	60.5 (31)	88.0 (31)	96.3 (26)	102.8 (22)	103.0 (18)	54.9 (8)	87.1 (10)	87.9 (21)
	Classroom Teachers, 1-6	5.0 (4)	29.6 (15)	53.8 (19)	107.5 (29)	158.5 (34)	212.7 (38)	311.9 (47)	381.8 (45)	140.6 (33)
	Special Teachers, 7 or more	6.3 (6)	5.3 (3)	17.8 (6)	31.0 (8)	42.2 (9)	41.3 (7)	20.1 (3)	20.6 (2)	26.0 (6)
	Special Teachers, 1-6	2.4 (2)	3.9 (2)	13.8 (5)	37.5 (10)	58.7 (12)	92.6 (17)	172.4 (26)	289.8 (34)	67.0 (16)
	Aides or Assistants, 1-10	17.3 (15)	27.2 (14)	25.3 (9)	28.0 (7)	25.9 (5)	24.2 (4)	15.1 (2)	8.0 (1)	23.9 (6)
	Tutor or Adult Volunteer, 1	0.5 (0)	1.8 (1)	1.6 (1)	1.8 (0)	2.6 (1)	2.1 (0)	1.9 (0)	0.5 (0)	1.8 (0)
	Independent, Programmed	1.6 (1)	11.5 (6)	5.0 (2)	6.4 (2)	7.8 (2)	8.9 (2)	5.8 (1)	6.0 (1)	7.1 (2)
	Independent, Non-Programmed	10.9 (10)	24.0 (12)	37.2 (13)	35.2 (9)	40.2 (9)	42.2 (8)	46.1 (7)	39.9 (5)	36.8 (9)
	Total Reading Services*	112.9	197.0	279.6	374.9	470.9	557.4	658.5	856.5	4[illegible]3.2
2	Number of CE Students	46	310	590	664	516	305	167	216	2,814
	Classroom Teachers, 21 or more	24.6 (25)	15.1 (9)	17.1 (6)	20.4 (6)	26.2 (6)	23.4 (4)	12.7 (2)	10.7 (1)	19.4 (5)
	Classroom Teachers, 14-20	3.1 (3)	14.7 (8)	16.4 (6)	13.3 (4)	7.3 (2)	[illegible].9 (2)	10.7 (2)	4.4 (0)	12.0 (3)
	Classroom Teachers, 7-13	14.7 (15)	56.6 (32)	106.0 (39)	116.1 (3[illegible])	95.3 (20)	105.0 (19)	96.0 (15)	52.7 (6)	94.7 (23)
	Classroom Teachers, 1-6	7.1 (7)	21.6 (12)	31.7 (12)	75.8 (2[illegible])	142.4 (31)	198.1 (34)	235.3 (36)	435.5 (49)	121.5 (29)
	Special Teachers, 7 or more	5.0 (5)	6.9 (4)	17.4 (6)	24.8 (7)	35.8 (8)	47.9 (8)	56.3 (9)	39.9 (4)	38.5 (7)
	Special Teachers, 1-6	0.0 (0)	3.4 (2)	20.6 (7)	50.9 (14)	90.8 (20)	119.0 (21)	179.3 (27)	287.9 (32)	79.0 (19)
	Aides or Assistants, 1-10	8.2 (8)	19.2 ([illegible])	20.7 (8)	23.0 (6)	20.9 (4)	20.0 (4)	20.7 (3)	13.2 (1)	20.3 (5)
	Tutor or Adult Volunteer, 1	0.0 (0)	0.5 (0)	1.4 (1)	2.5 (1)	2.[illegible] (0)	2.4 (0)	1.3 (0)	1.5 (0)	1.4 (0)
	Independent, Programmed	23.1 (23)	10.0 ([illegible])	4.7 (2)	6.8 (2)	8.7 (2)	7.7 (1)	5.1 (1)	6.0 (1)	7.3 (2)
	Independent, Non-Programmed	14.5 (14)	29.2 ([illegible])	37.9 (14)	37.6 (10)	36.5 (8)	37.1 (7)	42.5 (6)	39.7 (4)	3[illegible].6 (9)
	Total Reading Services*	100.2	176.6	[illegible]	369.6	465.0	564.5	660.0	891.1	419.9
3	Number of CE Students	21	325	606	539	423	278	186	214	2,592
	Classroom Teachers, 21 or more	20.7 (21)	16.8 (10)	25.1 (10)	19.3 ([illegible])	22.1 (5)	24.1 (5)	32.9 (5)	11.8 (1)	21.7 (6)
	Classroom Teachers, 14-20	26.3 (27)	19.3 (12)	15.1 (6)	7.8 (2)	11.5 (3)	7.6 (1)	8.2 (1)	13.1 (2)	12.1 (3)
	Classroom Teachers, 7-13	18.0 (18)	48.7 (30)	67.4 (27)	81.8 (24)	93.8 (22)	79.1 (15)	80.7 (13)	35.2 (4)	71.5 (19)
	Classroom Teachers, 1-6	1.1 (1)	16.8 (10)	46.3 (19)	87.4 (26)	100.2 (23)	175.8 (34)	205.9 (34)	330.6 (42)	108.4 (28)
	Special Teachers, 7 or more	4.3 (4)	8.8 (5)	16.7 (7)	37.2 (11)	46.4 (11)	42.3 (8)	44.0 (7)	25.0 (3)	30.1 (8)
	Special Teachers, 1-6	0.0 (0)	5.0 (3)	19.3 (8)	43.4 (13)	85.9 (20)	132.6 (26)	173.4 (29)	312.9 (40)	80.7 (21)
	Aides or Assistants, 1-10	4.9 (5)	16.4 (10)	23.8 (10)	19.6 (6)	19.8 (5)	16.7 (3)	19.6 (3)	16.0 (2)	19.5 (5)
	Tutor or Adult Volunteer, 1	0.0 (0)	0.3 (0)	1.3 (1)	0.8 (0)	1.3 (0)	1.7 (0)	2.7 (0)	0.5 (0)	1.2 (0)
	Independent, Programmed	2.9 (3)	4.1 (3)	3.4 (1)	5.2 (2)	6.3 (1)	7.3 (1)	9.0 (1)	10.1 (1)	5.7 (1)
	Independent, Non-Programmed	20.3 (20)	27.6 (17)	31.5 (13)	35.4 (11)	40.9 (10)	32.4 (6)	31.3 (5)	30.5 (4)	33.3 (9)
	Total Reading Services*	99.1	163.8	249.2	336.8	427.0	518.9	607.1	785.4	383.4
4	Number of CE Students	66	266	408	430	372	247	182	159	2,130
	Classroom Teachers, 21 or more	37.3 (37)	33.0 (20)	16.4 (7)	20.7 (6)	18.5 (5)	17.3 (4)	25.0 (4)	19.6 (3)	21.4 (6)
	Classroom Teachers, 14-20	21.7 (21)	17.9 (11)	9.5 (4)	18.6 (6)	14.3 (4)	10.9 (2)	6.0 (1)	9.4 (1)	13.5 (4)
	Classroom Teachers, 7-13	1.2 (1)	28.6 (17)	73.6 (30)	72.8 (23)	84.2 (21)	74.5 (15)	58.3 (10)	49.7 (7)	64.4 (18)
	Classroom Teachers, 1-6	1.6 (2)	14.6 (9)	37.1 (15)	55.3 (17)	70.6 (18)	129.6 (27)	204.8 (36)	323.0 (44)	89.1 (25)
	Special Teachers, 7 or more	5.6 (6)	15.6 (9)	24.6 (10)	32.4 (10)	45.6 (11)	45.1 (9)	44.8 (8)	49.6 (7)	34.1 (9)
	Special Teachers, 1-6	2.5 (2)	5.9 (4)	27.2 (11)	64.8 (20)	117.0 (29)	160.6 (33)	168.5 (30)	239.7 (33)	90.5 (25)
	Aides or Assistants, 1-10	4.5 (4)	13.9 (8)	17.2 (7)	14.8 (5)	11.2 ([illegible])	10.1 (2)	11.4 (2)	6.7 (1)	12.7 (4)
	Tutor or Adult Volunteer, 1	0.0 (0)	0.8 (0)	0.8 (0)	0.9 (0)	0.7 (0)	0.8 (0)	1.0 (0)	2.1 (0)	0.9 (0)
	Independent, Programmed	3.1 (3)	1.3 (1)	4.6 (2)	10.2 (3)	11.2 (3)	7.7 (2)	13.9 (2)	4.0 (1)	7.5 (2)
	Independent, Non-Programmed	24.2 (24)	32.4 (20)	32.3 (13)	31.8 (10)	28.5 (7)	28.6 (6)	29.1 (5)	22.8 (3)	29.9 (8)
	Total Reading Services*	101.9	164.0	242.0	321.3	400.8	484.4	562.3	726.5	363.3
5	Number of CE Students	44	211	461	401	396	190	141	160	2,004
	Classroom Teachers, 21 or more	55.5 (70)	38.6 (30)	29.0 (14)	27.9 (10)	23.4 (7)	18.7 (4)	19.1 (4)	17.7 (3)	26.7 (8)
	Classroom Teachers, 14-20	5.8 (7)	16.9 (13)	16.8 (8)	7.8 (3)	10.6 (3)	10.1 (2)	9.3 (2)	11.3 (2)	11.9 (4)
	Classroom Teachers, 7-13	1.3 (2)	19.2 (15)	55.3 (27)	62.3 (23)	84.3 (24)	60.5 (14)	56.9 (11)	28.6 (4)	55.9 (17)
	Classroom Teachers, 1-6	0.0 (0)	6.8 (5)	22.7 (11)	56.2 (20)	71.0 (20)	122.8 (28)	154.7 (30)	253.7 (37)	74.0 (23)
	Special Teachers, 7 or more	0.0 (0)	6.7 (5)	24.8 (12)	35.8 (13)	38.8 (11)	20.1 (5)	20.9 (4)	15.2 (2)	25.8 (8)
	Special Teachers, 1-6	0.0 (0)	3.8 (3)	10.8 (5)	35.2 (13)	78.5 (22)	152.8 (35)	197.1 (39)	311.1 (46)	78.7 (25)
	Aides or Assistants, 1-10	1.3 (2)	9.8 (8)	11.6 (6)	15.1 (5)	12.2 (3)	10.1 (2)	15.8 (3)	11.7 (2)	12.1 (4)
	Tutor or Adult Volunteer, 1	0.0 (0)	0.1 (0)	1.0 (0)	1.5 (1)	1.4 (0)	0.8 (0)	0.8 (0)	1.7 (0)	1.1 (0)
	Independent, Programmed	0.2 (0)	7.3 (6)	7.7 (4)	5.4 (2)	9.5 (3)	11.0 (3)	11.7 (2)	7.1 (1)	7.9 (2)
	Independent, Non-Programmed	14.5 (18)	18.8 (15)	23.7 (12)	30.8 (11)	29.9 (8)	26.6 (6)	26.1 (5)	23.9 (4)	26.1 (8)
	Total Reading Services*	79.1	128.2	203.0	276.9	358.1	432.6	511.9	682.0	319.6
6	Number of CE Students	31	244	428	448	328	237	122	178	2,016
	Classroom Teachers, 21 or more	22.0 (47)	34.7 (32)	20.9 (12)	21.9 (8)	17.5 (5)	20.8 (5)	19.4 (4)	10.7 (2)	21.3 (7)
	Classroom Teachers, 14-20	1.0 (2)	12.9 (12)	22.6 (12)	26.9 (10)	24.2 (7)	21.7 (5)	12.0 (2)	11.4 (2)	20.1 (7)
	Classroom Teachers, 7-13	3.4 (7)	20.9 (19)	40.6 (22)	53.7 (21)	53.9 (16)	45.5 (11)	55.1 (11)	54.0 (8)	45.3 (15)
	Classroom Teachers, 1-6	15.5 (33)	7.6 (7)	28.4 (16)	48.3 (19)	79.0 (24)	96.0 (23)	107.6 (22)	204.5 (32)	66.6 (22)
	Special Teachers, 7 or more	0.0 (0)	7.3 (7)	17.4 (10)	23.7 (9)	41.4 (12)	56.1 (14)	37.2 (8)	41.8 (7)	29.1 (10)
	Special Teachers, 1-6	0.0 (0)	1.8 (2)	13.1 (7)	30.6 (12)	69.8 (21)	125.2 (30)	212.2 (44)	273.2 (43)	72.8 (24)
	Aides or Assistants, 1-10	0.0 (0)	2.8 (3)	9.4 (5)	16.2 (6)	10.9 (3)	13.3 (3)	13.0 (3)	8.5 (1)	10.8 (4)
	Tutor or Adult Volunteer, 1	0.0 (0)	0.3 (0)	0.6 (0)	2.3 (1)	0.3 (0)	1.2 (0)	1.3 (0)	0.6 (0)	1.0 (0)
	Independent, Programmed	0.4 (1)	4.1 (4)	9.0 (5)	7.8 (3)	9.3 (3)	8.1 (2)	5.1 (1)	11.6 (2)	8.0 (3)
	Independent, Non-Programmed	4.5 (10)	17.8 (26)	19.5 (11)	26.8 (10)	27.6 (8)	23.5 (6)	25.7 (5)	21.7 (3)	23.0 (8)
	Total Reading Services*	46.8	109.9	181.1	257.5	333.6	411.3	487.7	637.1	290.[illegible]

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*The percentages are obtained as the ratio (expressed in percents) of mean costs in each setting to mean total costs. Discrepancies between total costs and sum of costs for the 10 instructional settings, and discrepancies between sum of the 10 percentages and 100 are due to rounding errors.

Table D-6

Means and Corresponding Percentages (in Parenthesis) of Yearly Hours of Math Services Received per Instructional Setting for CE Students, by Eight Levels of the Total Standard-Resource-Dollar Costs for Math Services at Each Grade

GRADE	Instructional Setting	Cost Levels Defined in Terms of Mean (M) and Standard Deviation (S) of the Distribution of Total Service Costs for CE Students in Each Grade - Each Level Covers the Costs that are Greater than the Lower Bound (L) but Less than or Equal to the Upper Bound (U) Given Below								All Math CE Students
	Type of Instructors, Size of Group (or Materials Used) L: U:	Lowest M - 1.5S	M - 1.5S M - 1.0S	M - 1.0S M - 0.5S	M - 0.5S M	M M + 0.5S	M + 0.5S M + 1.0S	M + 1.0S M + 1.5S	M + 1.5S Highest	
	Number of CE Students	0	161	315	354	249	170	62	97	1,408
	Classroom Teachers, 21 or more	NA	50.1 (46)	46.4 (31)	28.5 (18)	23.2 (13)	25.7 (15)	23.9 (13)	17.6 (8)	32.7 (20)
	Classroom Teachers, 14-20	NA	2.5 (2)	19.2 (13)	16.0 (10)	16.5 (9)	13.1 (7)	6.5 (3)	10.1 (5)	14.1 (9)
	Classroom Teachers, 7-13	NA	2.6 (2)	10.0 (7)	26.8 (17)	38.3 (22)	36.3 (21)	26.6 (14)	19.4 (9)	22.9 (14)
	Classroom Teachers, 1-6	NA	1.7 (2)	4.3 (3)	9.5 (6)	15.2 (9)	27.5 (16)	41.6 (22)	59.7 (27)	15.5 (10)
	Special Teachers, 7 or more	NA	3.7 (3)	3.2 (2)	6.0 (4)	12.3 (7)	7.6 (4)	9.8 (5)	15.4 (7)	7.2 (5)
1	Special Teachers, 1-6	NA	0.3 (0)	0.8 (1)	2.2 (1)	4.7 (3)	5.0 (3)	11.1 (6)	28.6 (13)	4.7 (3)
	Aides or Assistants, 1-10	NA	7.3 (7)	14.6 (10)	16.3 (11)	19.4 (11)	20.3 (11)	23.1 (12)	18.1 (8)	16.3 (10)
	Tutor or Adult Volunteer, 1	NA	1.0 (1)	2.2 (1)	1.1 (1)	0.7 (0)	0.1 (0)	2.3 (1)	2.6 (1)	1.3 (1)
	Independent, Programmed	NA	1.2 (1)	0.9 (1)	3.4 (2)	6.1 (4)	5.8 (3)	4.7 (3)	4.0 (2)	3.4 (2)
	Independent, Non-Programmed	NA	38.2 (35)	46.8 (32)	45.2 (29)	38.7 (22)	35.3 (20)	37.6 (20)	46.0 (21)	42.1 (26)
	Total Math Services*	NA	108.6	148.5	154.8	175.1	176.9	187.5	221.6	160.4
	Number of CE Students	0	148	403	361	248	169	103	112	1,544
	Classroom Teachers, 21 or more	NA	40.6 (38)	50.3 (33)	38.8 (23)	32.2 (18)	29.0 (15)	20.5 (10)	30.0 (13)	38.0 (22)
	Classroom Teachers, 14-20	NA	3.3 (3)	17.4 (11)	21.9 (13)	12.1 (7)	7.5 (4)	13.7 (7)	6.7 (3)	14.2 (8)
	Classroom Teachers, 7-13	NA	1.6 (2)	10.5 (7)	20.8 (12)	30.5 (17)	35.6 (18)	27.1 (13)	21.9 (9)	19.9 (12)
	Classroom Teachers, 1-6	NA	1.2 (1)	2.1 (1)	5.9 (3)	14.2 (8)	26.2 (13)	31.0 (15)	61.8 (26)	13.7 (8)
	Special Teachers, 7 or more	NA	0.5 (0)	0.5 (0)	4.3 (2)	5.0 (3)	9.4 (5)	15.2 (7)	15.0 (6)	5.1 (3)
2	Special Teachers, 1-6	NA	0.1 (0)	0.2 (0)	1.6 (1)	5.0 (3)	6.7 (3)	18.7 (9)	33.4 (14)	5.6 (3)
	Aides or Assistants, 1-10	NA	2.4 (2)	10.0 (7)	17.3 (10)	26.1 (15)	21.4 (11)	16.1 (8)	10.6 (4)	15.2 (9)
	Tutor or Adult Volunteer, 1	NA	0.0 (0)	0.9 (1)	1.9 (1)	2.9 (2)	2.0 (1)	5.3 (3)	3.7 (2)	2.0 (1)
	Independent, Programmed	NA	0.4 (0)	12.6 (8)	7.2 (4)	7.2 (4)	8.0 (4)	3.8 (2)	2.0 (1)	7.4 (4)
	Independent, Non-Programmed	NA	56.5 (53)	48.3 (32)	52.1 (30)	42.2 (24)	51.3 (26)	56.3 (27)	51.8 (22)	50.1 (29)
	Total Math Services*	NA	106.4	152.8	171.6	177.4	197.1	208.0	237.0	171.4
	Number of CE Students	2	164	410	341	276	135	82	145	1,555
	Classroom Teachers, 21 or more	95.6 (78)	63.2 (41)	55.3 (32)	39.9 (23)	37.8 (20)	31.2 (15)	27.7 (13)	54.4 (22)	46.1 (25)
	Classroom Teachers, 14-20	0.0 (0)	5.8 (4)	20.2 (12)	14.0 (8)	9.3 (5)	16.7 (8)	16.2 (7)	10.8 (4)	14.0 (8)
	Classroom Teachers, 7-13	0.0 (0)	7.8 (5)	12.5 (7)	18.4 (11)	29.4 (16)	32.3 (16)	27.2 (12)	17.5 (7)	19.2 (10)
	Classroom Teachers, 1-6	0.0 (0)	2.6 (2)	6.0 (3)	15.9 (9)	18.3 (10)	26.0 (13)	30.4 (14)	36.9 (15)	15.9 (9)
	Special Teachers, 7 or more	0.0 (0)	2.1 (1)	2.5 (1)	9.8 (6)	11.3 (6)	12.8 (6)	12.6 (6)	18.1 (7)	8.5 (5)
3	Special Teachers, 1-6	0.0 (0)	0.4 (0)	1.7 (1)	4.6 (3)	8.6 (5)	12.8 (6)	24.3 (11)	48.6 (20)	10.0 (5)
	Aides or Assistants, 1-10	1.6 (1)	6.9 (4)	13.7 (8)	13.2 (8)	15.8 (8)	16.9 (8)	26.1 (12)	13.9 (6)	14.2 (8)
	Tutor or Adult Volunteer, 1	0.0 (0)	0.9 (1)	1.2 (1)	2.0 (1)	1.2 (1)	0.8 (0)	1.0 (0)	0.5 (0)	1.2 (1)
	Independent, Programmed	0.0 (0)	6.6 (4)	7.2 (4)	3.9 (2)	4.9 (3)	8.2 (4)	12.0 (5)	4.1 (2)	6.0 (3)
	Independent, Non-Programmed	25.2 (21)	58.4 (38)	50.9 (30)	52.1 (30)	51.2 (27)	44.6 (22)	41.8 (19)	38.3 (16)	49.8 (27)
	Total Math Services*	122.3	154.8	171.2	174.0	187.8	202.5	219.6	243.1	185.0
	Number of CE Students	0	110	419	303	212	134	64	117	1,359
	Classroom Teachers, 21 or more	NA	58.4 (40)	59.6 (35)	45.8 (26)	45.6 (23)	55.4 (22)	36.9 (16)	35.8 (13)	50.7 (26)
	Classroom Teachers, 14-20	NA	15.7 (11)	16.8 (10)	17.7 (10)	11.0 (5)	10.1 (4)	7.7 (3)	10.2 (4)	14.3 (7)
	Classroom Teachers, 7-13	NA	0.7 (0)	9.8 (6)	19.9 (11)	30.2 (15)	41.3 (16)	26.6 (12)	24.4 (9)	19.6 (10)
	Classroom Teachers, 1-6	NA	1.4 (1)	3.8 (2)	16.5 (9)	17.9 (9)	18.2 (7)	30.6 (14)	79.2 (29)	17.8 (9)
	Special Teachers, 7 or more	NA	1.0 (1)	5.2 (3)	7.4 (4)	11.9 (6)	6.9 (3)	8.8 (4)	18.0 (7)	7.8 (4)
4	Special Teachers, 1-6	NA	0.0 (0)	1.3 (1)	5.7 (3)	11.5 (6)	27.4 (11)	44.1 (20)	39.9 (14)	11.7 (6)
	Aides or Assistants, 1-10	NA	5.2 (4)	11.8 (7)	11.6 (6)	9.6 (5)	16.0 (6)	10.8 (5)	11.4 (4)	11.2 (6)
	Tutor or Adult Volunteer, 1	NA	0.3 (0)	0.7 (0)	1.8 (1)	0.7 (0)	1.6 (1)	1.3 (1)	6.7 (2)	1.5 (1)
	Independent, Programmed	NA	5.2 (4)	7.7 (4)	6.5 (4)	15.4 (8)	13.3 (5)	14.3 (6)	11.7 (4)	9.7 (5)
	Independent, Non-Programmed	NA	58.9 (40)	55.7 (32)	45.8 (26)	49.1 (24)	64.2 (25)	44.8 (20)	38.7 (14)	51.6 (26)
	Total Math Services*	NA	146.6	172.4	178.7	202.8	254.4	226.2	276.2	196.0
	Number of CE Students	0	123	351	305	233	125	76	99	1,312
	Classroom Teachers, 21 or more	NA	109.6 (78)	61.9 (38)	45.0 (24)	28.8 (14)	42.5 (21)	53.0 (22)	46.9 (17)	53.1 (28)
	Classroom Teachers, 14-20	NA	3.0 (2)	14.7 (9)	8.5 (5)	7.1 (3)	7.1 (3)	2.6 (1)	14.8 (6)	9.4 (5)
	Classroom Teachers, 7-13	NA	0.8 (1)	15.3 (9)	31.1 (17)	39.3 (19)	18.9 (9)	29.4 (12)	21.4 (8)	23.5 (12)
	Classroom Teachers, 1-6	NA	0.3 (0)	4.3 (3)	13.3 (7)	25.9 (13)	41.3 (20)	32.0 (13)	46.6 (17)	18.2 (10)
	Special Teachers, 7 or more	NA	1.0 (1)	6.1 (4)	9.6 (5)	12.5 (6)	12.2 (6)	19.9 (8)	11.1 (4)	9.3 (5)
5	Special Teachers, 1-6	NA	0.2 (0)	1.8 (1)	6.1 (3)	11.3 (5)	23.5 (12)	46.3 (19)	76.9 (29)	14.7 (8)
	Aides or Assistants, 1-10	NA	3.7 (3)	14.2 (9)	15.5 (8)	9.8 (5)	8.9 (4)	16.6 (7)	13.4 (5)	12.3 (6)
	Tutor or Adult Volunteer, 1	NA	0.5 (0)	1.5 (1)	1.6 (1)	1.1 (1)	2.9 (1)	2.5 (1)	3.5 (1)	1.7 (1)
	Independent, Programmed	NA	0.4 (0)	7.3 (4)	11.1 (6)	14.1 (7)	4.9 (2)	9.9 (4)	8.2 (3)	8.7 (5)
	Independent, Non-Programmed	NA	21.0 (15)	36.9 (22)	46.3 (25)	56.4 (27)	41.6 (20)	28.9 (12)	25.4 (9)	40.2 (21)
	Total Math Services*	NA	140.7	164.1	188.2	206.5	203.8	241.2	268.0	191.1
	Number of CE Students	0	118	414	385	212	103	82	123	1,437
	Classroom Teachers, 21 or more	NA	71.0 (56)	65.1 (41)	39.7 (24)	32.1 (17)	15.4 (8)	17.5 (9)	28.7 (11)	44.5 (25)
	Classroom Teachers, 14-20	NA	17.4 (14)	11.5 (7)	16.4 (10)	7.2 (4)	8.1 (4)	24.5 (12)	18.3 (7)	13.8 (8)
	Classroom Teachers, 7-13	NA	0.6 (0)	4.3 (3)	17.6 (11)	31.7 (17)	19.8 (11)	30.5 (15)	54.7 (21)	18.5 (11)
	Classroom Teachers, 1-6	NA	0.6 (0)	5.6 (4)	15.5 (9)	16.8 (9)	40.0 (21)	42.2 (21)	33.8 (13)	16.4 (9)
	Special Teachers, 7 or more	NA	0.2 (0)	3.7 (2)	10.7 (7)	17.2 (9)	15.2 (8)	12.8 (6)	45.8 (17)	12.2 (7)
6	Special Teachers, 1-6	NA	0.2 (0)	1.3 (1)	3.3 (2)	8.9 (5)	15.3 (8)	24.1 (12)	52.6 (20)	9.6 (5)
	Aides or Assistants, 1-10	NA	2.6 (2)	7.0 (4)	9.7 (6)	15.3 (8)	20.8 (11)	13.5 (7)	3.2 (1)	9.6 (5)
	Tutor or Adult Volunteer, 1	NA	0.6 (0)	1.7 (1)	1.1 (1)	3.7 (2)	2.4 (1)	2.0 (1)	1.1 (0)	1.8 (1)
	Independent, Programmed	NA	4.3 (3)	14.7 (9)	10.1 (6)	9.4 (5)	14.9 (8)	6.4 (3)	2.1 (1)	10.3 (6)
	Independent, Non-Programmed	NA	29.3 (23)	43.1 (27)	39.8 (24)	43.1 (23)	36.3 (19)	29.3 (14)	23.3 (9)	38.1 (22)
	Total Math Services*	NA	126.8	158.0	164.0	186.0	188.4	203.0	263.6	175.0

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*The percentages are obtained as mean hours in each setting divided by mean total hours and then multiplied by 100. Discrepancies between the mean total hours of services and the sum of means in the 10 settings, and discrepancies between the sum of the 10 percentages and 100 are due to rounding errors.

Table D-7

Means and Corresponding Percentages (in Parenthesis) of Standard-Resource-Dollar Costs of Math Services Received per Instructional Setting for CE Students by Eight Levels of the Total Costs for Math Services at Each Grade

GRADE	Instructional Setting Type of Instructors, Size of Group (or Materials Used)	Cost Levels Defined in Terms of Mean (M) and Standard Deviation (S) of the Distribution of Total Service Costs for CE Students in Each Grade - Each Level Covers the Costs that are Greater than the Lower Bound (L) but Less than or Equal to the Upper Bound (U) Given Below								All Math CE Students
	L: U:	Lowest M - 1.5S	M - 1.5S M - 1.0S	M - 1.0S M - 0.5S	M - 0.5S M	M M + 0.5S	M + 0.5S M + 1.0S	M + 1.0S M + 1.5S	M + 1.5S Highest	
1	Number of CE Students	0	161	315	354	249	170	62	97	1,408
	Classroom Teachers, 21 or more	NA	27.3 (40)	29.1 (25)	18.6 (12)	14.8 (7)	17.0 (7)	16.4 (5)	12.6 (3)	20.6 (11)
	Classroom Teachers, 14-20	NA	2.0 (3)	16.3 (14)	14.4 (9)	15.2 (7)	11.3 (4)	6.2 (2)	9.4 (2)	12.5 (7)
	Classroom Teachers, 7-13	NA	3.4 (5)	12.9 (11)	36.4 (23)	52.2 (25)	55.4 (22)	40.8 (14)	29.2 (7)	32.2 (17)
	Classroom Teachers, 1-6	NA	5.4 (8)	13.4 (12)	29.1 (18)	47.0 (23)	91.6 (36)	132.7 (44)	201.1 (46)	50.0 (27)
	Special Teachers, 7 or more	NA	4.4 (7)	3.4 (3)	9.4 (6)	19.3 (9)	16.1 (6)	14.7 (5)	31.3 (7)	11.8 (6)
	Special Teachers, 1-6	NA	0.7 (1)	2.9 (3)	10.4 (7)	18.2 (9)	19.5 (8)	42.8 (14)	111.4 (25)	18.5 (10)
	Aides or Assistants, 1-10	NA	6.2 (9)	12.6 (11)	14.3 (9)	17.1 (8)	18.5 (7)	21.5 (7)	16.0 (4)	14.4 (8)
	Tutor or Adult Volunteer, 1	NA	0.5 (1)	1.0 (1)	0.4 (0)	0.3 (0)	0.1 (0)	1.3 (0)	1.1 (0)	0.6 (0)
	Independent, Programmed	NA	0.6 (1)	0.5 (0)	1.8 (1)	3.5 (2)	3.4 (1)	2.7 (1)	2.2 (1)	1.9 (1)
	Independent, Non-Programmed	NA	17.4 (26)	23.1 (20)	22.9 (15)	19.6 (9)	19.5 (8)	21.0 (7)	24.3 (6)	21.3 (12)
	Total Math Services*	NA	68.0	115.2	157.8	207.3	252.4	300.1	438.8	183.8
2	Number of CE Students	0	148	403	361	248	169	103	112	1,544
	Classroom Teachers, 21 or more	NA	25.8 (40)	31.9 (30)	26.2 (17)	21.0 (10)	17.6 (7)	12.8 (4)	18.6 (4)	24.4 (13)
	Classroom Teachers, 14-20	NA	2.7 (4)	14.6 (14)	17.8 (12)	10.9 (5)	6.8 (3)	11.7 (4)	6.0 (1)	11.9 (6)
	Classroom Teachers, 7-13	NA	2.3 (4)	13.9 (13)	29.0 (19)	43.9 (21)	51.3 (20)	37.3 (12)	30.7 (7)	28.0 (15)
	Classroom Teachers, 1-6	NA	4.2 (7)	6.3 (6)	19.5 (13)	45.7 (22)	86.4 (33)	101.7 (33)	203.4 (46)	44.9 (24)
	Special Teachers, 7 or more	NA	0.5 (1)	0.6 (1)	8.4 (5)	13.0 (6)	24.2 (9)	29.1 (9)	24.2 (5)	10.6 (6)
	Special Teachers, 1-6	NA	0.2 (0)	0.4 (0)	6.0 (4)	22.0 (11)	24.3 (9)	73.6 (24)	125.2 (28)	21.7 (12)
	Aides or Assistants, 1-10	NA	2.0 (3)	9.0 (8)	15.0 (10)	22.6 (11)	18.1 (7)	13.4 (4)	8.9 (2)	13.2 (7)
	Tutor or Adult Volunteer, 1	NA	0.0 (0)	0.4 (0)	0.8 (1)	1.3 (1)	0.9 (0)	2.3 (1)	1.6 (0)	0.9 (0)
	Independent, Programmed	NA	0.1 (0)	6.2 (6)	3.8 (2)	4.1 (2)	4.6 (2)	1.8 (1)	1.0 (0)	3.9 (2)
	Independent, Non-Programmed	NA	26.8 (42)	23.2 (22)	26.7 (17)	21.7 (11)	24.8 (10)	26.6 (9)	24.0 (5)	24.6 (13)
	Total Math Services*	NA	64.5	106.5	153.3	206.2	259.1	310.5	443.7	184.2
3	Number of CE Students	2	164	410	341	276	135	82	145	1,555
	Classroom Teachers, 21 or more	44.4 (83)	37.0 (38)	34.0 (25)	24.9 (13)	24.5 (10)	21.2 (7)	17.6 (5)	34.1 (8)	28.7 (13)
	Classroom Teachers, 14-20	0.0 (0)	4.7 (5)	17.0 (13)	13.4 (7)	8.6 (4)	14.8 (5)	15.1 (4)	9.6 (2)	12.4 (6)
	Classroom Teachers, 7-13	0.0 (0)	9.9 (10)	16.2 (12)	25.1 (13)	40.9 (17)	46.6 (16)	38.8 (11)	24.9 (6)	26.5 (12)
	Classroom Teachers, 1-6	0.0 (0)	7.0 (7)	18.4 (14)	50.6 (27)	58.5 (25)	85.1 (30)	98.6 (29)	123.2 (27)	51.1 (24)
	Special Teachers, 7 or more	0.0 (0)	1.6 (2)	4.0 (3)	17.9 (10)	26.5 (11)	24.4 (9)	21.1 (6)	34.3 (8)	16.3 (8)
	Special Teachers, 1-6	0.0 (0)	1.2 (1)	5.9 (4)	16.2 (9)	34.5 (15)	49.4 (17)	92.7 (27)	187.9 (42)	38.0 (18)
	Aides or Assistants, 1-10	1.3 (2)	5.6 (6)	11.3 (8)	11.2 (6)	13.8 (6)	15.9 (6)	24.3 (7)	12.6 (3)	12.3 (6)
	Tutor or Adult Volunteer, 1	0.0 (0)	0.4 (0)	0.5 (0)	0.8 (0)	0.5 (0)	0.4 (0)	0.4 (0)	0.2 (0)	0.5 (0)
	Independent, Programmed	0.0 (0)	3.3 (3)	3.7 (3)	2.1 (1)	2.6 ([illegible])	5.0 (2)	7.1 (2)	2.6 (1)	3.3 (2)
	Independent, Non-Programmed	7.9 (15)	25.8 (27)	23.8 ([illegible])	25.5 (14)	25.1 (11)	22.8 (8)	21.7 (6)	19.3 (4)	24.0 (11)
	Total Math Services*	53.6	96.5	134.8	187.8	235.5	285.6	337.5	468.7	213.2
4	Number of CE Students	0	110	419	303	212	134	64	117	1,359
	Classroom Teachers, 21 or more	NA	34.6 (41)	41.1 (30)	30.4 (15)	32.9 (12)	34.7 (10)	23.9 (6)	24.7 (4)	34.1 (14)
	Classroom Teachers, 14-20	NA	11.8 (14)	15.3 (11)	16.1 (8)	10.1 (4)	8.4 (2)	7.0 (2)	9.2 (2)	12.8 (5)
	Classroom Teachers, 7-13	NA	0.9 (1)	13.3 (10)	27.9 (14)	44.3 (16)	59.8 (17)	37.5 (9)	37.5 (6)	26.2 (12)
	Classroom Teachers, 1-6	NA	3.5 (4)	11.9 (9)	52.3 (26)	56.8 (21)	64.5 (19)	100.9 (24)	271.2 (47)	58.9 (25)
	Special Teachers, 7 or more	NA	1.0 (1)	6.4 (5)	17.5 (9)	39.4 (15)	15.0 (4)	20.9 (5)	38.8 (7)	17.9 (8)
	Special Teachers, 1-6	NA	0.1 (0)	4.7 (3)	20.8 (10)	41.8 (16)	103.5 (30)	179.3 (43)	155.2 (27)	44.6 (19)
	Aides or Assistants, 1-10	NA	4.4 (5)	10.4 (8)	10.2 (5)	8.2 (3)	13.4 (4)	10.4 (3)	11.6 (2)	9.9 (4)
	Tutor or Adult Volunteer, 1	NA	0.1 (0)	0.3 (0)	0.7 (0)	0.4 (0)	1.1 (0)	0.6 (0)	3.6 (1)	0.8 (0)
	Independent, Programmed	NA	2.5 (3)	4.4 (3)	3.9 (2)	9.[illegible] (4)	7.9 (2)	10.7 (3)	8.0 (1)	5.9 (2)
	Independent, Non-Programmed	NA	24.7 (30)	27.4 (20)	22.8 (11)	24.[illegible] (9)	33.2 (10)	22.0 (5)	20.7 (4)	25.5 (11)
	Total Math Services*	NA	83.6	135.2	202.7	268.[illegible]	341.4	413.4	580.5	238.6
5	Number of CE Students	0	123	351	335	233	125	76	99	1,312
	Classroom Teachers, 21 or more	NA	55.6 (77)	39.7 (29)	27.5 (14)	18.2 (7)	27.5 (8)	35.7 (9)	32.8 (6)	32.6 (14)
	Classroom Teachers, 14-20	NA	2.1 (3)	12.4 (9)	[illegible].8 (4)	6.5 (2)	6.0 (2)	2.2 (1)	13.1 (2)	8.2 (3)
	Classroom Teachers, 7-13	NA	0.9 (1)	20.6 (15)	44.6 (22)	53.7 (20)	25.7 (8)	43.4 (11)	31.7 (6)	32.9 (14)
	Classroom Teachers, 1-6	NA	1.1 (2)	12.9 (10)	42.6 (21)	81.1 (31)	137.0 (41)	103.4 (25)	158.5 (28)	58.9 (25)
	Special Teachers, 7 or more	NA	0.7 (1)	8.1 (6)	12.9 (6)	18.2 (7)	19.0 (6)	24.5 (6)	17.8 (3)	13.0 (6)
	Special Teachers, 1-6	NA	0.5 (1)	6.8 (5)	20.1 (10)	42.3 (16)	82.2 (25)	160.6 (39)	281.4 (49)	52.4 (22)
	Aides or Assistants, 1-10	NA	2.9 (4)	11.9 (9)	14.3 (7)	8.5 (3)	8.3 (2)	14.9 (4)	12.6 (2)	10.9 (5)
	Tutor or Adult Volunteer, 1	NA	0.2 (0)	0.7 (1)	0.8 (0)	0.5 (0)	1.6 (0)	1.1 (0)	2.0 (0)	0.8 (0)
	Independent, Programmed	NA	0.2 (0)	3.9 (3)	6.4 (3)	7.8 (3)	3.5 (1)	6.4 (2)	5.2 (1)	5.0 (2)
	Independent, Non-Programmed	NA	8.0 (11)	17.7 (13)	23.6 (12)	27.1 (10)	22.0 (7)	14.6 (4)	13.4 (2)	19.8 (8)
	Total Math Services*	NA	72.3	134.9	200.6	264.0	332.7	406.7	568.7	234.5
6	Number of CE Students	0	118	414	385	212	103	82	123	1,437
	Classroom Teachers, 21 or more	NA	37.7 (57)	42.9 (37)	25.7 (15)	21.5 (9)	9.6 (3)	11.6 (3)	17.7 (3)	28.4 (14)
	Classroom Teachers, 14-20	NA	10.3 (16)	10.4 (9)	15.1 (9)	6.7 (3)	7.3 (2)	22.8 (6)	16.0 (3)	12.1 (6)
	Classroom Teachers, 7-13	NA	0.6 (1)	5.2 (5)	23.9 (14)	46.7 (20)	27.3 (9)	43.7 (12)	83.2 (16)	26.4 (13)
	Classroom Teachers, 1-6	NA	1.4 (2)	15.7 (14)	48.3 (27)	56.0 (24)	126.7 (42)	137.4 (39)	112.2 (22)	52.4 (25)
	Special Teachers, 7 or more	NA	0.1 (0)	4.3 (4)	17.5 (10)	25.2 (11)	26.4 (9)	22.5 (6)	83.0 (16)	19.9 (10)
	Special Teachers, 1-6	NA	0.7 (1)	3.6 (3)	11.7 (7)	34.6 (15)	57.9 (19)	87.3 (25)	181.2 (36)	34.0 (16)
	Aides or Assistants, 1-10	NA	2.1 (3)	6.1 (5)	8.5 (5)	14.3 (6)	17.1 (6)	11.8 (3)	3.2 (1)	8.5 (4)
	Tutor or Adult Volunteer, 1	NA	0.2 (0)	0.6 (1)	0.5 (0)	2.2 (1)	1.2 (0)	1.1 (0)	0.6 (0)	0.9 (0)
	Independent, Programmed	NA	2.2 (3)	7.3 (6)	5.3 (3)	5.4 (2)	8.6 (3)	3.5 (1)	1.5 (0)	5.4 (3)
	Independent, Non-Programmed	NA	10.7 (16)	20.1 (17)	19.0 (11)	23.1 (10)	17.7 (6)	14.4 (4)	11.0 (2)	18.2 (9)
	Total Math Services*	NA	66.0	116.3	175.6	235.7	299.7	356.1	509.5	206.1

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*The percentages are obtained as the ratio (expressed in percents) of mean costs in each setting to mean total costs. Discrepancies between total costs and sum of costs for the 10 instructional settings, and discrepancies between sum of the 10 percentages and 100 are due to rounding errors.

Table D-8

Means and Corresponding Percentages (in Parenthesis) of Yearly Hours of Reading Services Received in Three Kinds of Instruction (Regular, Special, and Tutor/Independent), by CE Categories and Four Levels of the Total Costs for Reading Services at Each Grade

Cost Level*	Kind of Instruction*	CE Categories: TI/TI = Title I Students; OCE/TI = Other-CE Students in Title I Schools; OCE/OCE = Other-CE Students in Other-CE Schools; NNCE/NCE = Non-CE Students Needing CE but in Schools That do not Provide it; and NNCE/CE = Non-CE Students Needing CE and Attending Schools That Provide it									
		For Grades 1, 3, and 5					For Grades 2, 4, and 6				
		TI/TI	OCE/TI	OCE/OCE	NNCE/NCE	NNCE/CE	TI/TI	OCE/TI	OCE/OCE	NNCE/NCE	NNCE/CE
		Grade 1					Grade 2				
Low	N	192	102	22	79	295	251	90	15	116	234
	Regular	90.8 (42)	94.9 (49)	82.1 (41)	129.2 (55)	118.1 (58)	70.4 (40)	100.8 (49)	78.1 (40)	113.8 (52)	131.8 (57)
	Special	50.7 (24)	35.8 (18)	30.1 (15)	9.0 (4)	11.1 (5)	35.7 (20)	25.2 (12)	26.9 (14)	9.8 (4)	13.7 (6)
	Tutor/Ind.	73.5 (34)	64.6 (33)	89.9 (44)	97.5 (41)	75.6 (37)	68.3 (39)	78.1 (38)	88.3 (46)	93.6 (43)	87.0 (37)
	Total	215.1	195.6	202.0	235.7	204.8	174.5	204.2	193.3	217.1	232.6
Low Average	N	686	250	151	137	593	746	118	188	148	459
	Regular	113.3 (40)	126.2 (43)	106.8 (42)	187.3 (61)	138.6 (47)	124.9 (44)	130.2 (48)	110.8 (39)	111.4 (45)	129.0 (46)
	Special	89.7 (31)	63.4 (22)	55.7 (22)	26.2 (9)	48.9 (16)	74.9 (26)	47.9 (18)	60.0 (21)	46.9 (19)	42.3 (15)
	Tutor/Ind.	82.4 (29)	100.6 (35)	89.5 (36)	91.4 (30)	110.0 (37)	82.9 (29)	90.7 (34)	109.9 (39)	91.7 (37)	109.2 (39)
	Total	285.5	290.6	252.1	305.0	297.6	282.9	268.8	281.0	250.1	280.7
High Average	N	444	98	110	70	219	522	130	169	50	198
	Regular	126.2 (34)	146.6 (41)	54.8 (20)	161.4 (42)	133.4 (38)	126.4 (38)	141.8 (43)	64.5 (22)	175.9 (52)	100.9 (31)
	Special	134.4 (37)	108.8 (30)	136.1 (49)	98.5 (25)	110.5 (32)	119.8 (36)	109.2 (33)	121.3 (41)	73.8 (22)	109.3 (33)
	Tutor/Ind.	106.7 (29)	101.3 (28)	88.1 (32)	126.7 (33)	104.2 (30)	86.2 (26)	81.0 (24)	110.5 (37)	91.8 (27)	120.1 (36)
	Total	367.8	357.1	279.0	386.5	348.2	332.9	332.6	296.5	341.5	330.5
High	N	234	69	56	18	133	284	45	54	6	59
	Regular	90.0 (23)	109.5 (29)	70.7 (18)	64.4 (17)	95.8 (25)	77.2 (20)	79.9 (20)	34.8 (11)	118.5 (30)	39.6 (11)
	Special	200.9 (51)	196.0 (51)	202.4 (51)	218.4 (57)	195.0 (51)	217.7 (57)	221.3 (54)	195.3 (59)	165.9 (42)	215.5 (62)
	Tutor/Ind.	101.9 (26)	77.7 (20)	120.6 (31)	101.4 (26)	88.8 (23)	88.3 (23)	105.0 (26)	100.0 (30)	115.2 (29)	92.2 (27)
	Total	393.1	383.2	394.4	384.2	379.7	383.3	406.2	330.4	399.5	347.7
		Grade 3					Grade 4				
Low	N	187	97	62	68	258	201	66	65	179	447
	Regular	79.5 (42)	98.0 (52)	93.6 (51)	122.2 (62	109.4 (56)	87.8 (47)	86.5 (50)	84.3 (48)	132.1 (73)	97.4 (55)
	Special	47.6 (25)	19.3 (10)	15.6 (8)	11.2 (6)	12.9 (7)	35.7 (19)	14.5 (8)	26.4 (15)	3.6 (2)	8.8 (5)
	Tutor/Ind.	60.2 (32)	70.1 (37)	74.7 (40)	64.3 (33)	71.2 (37)	62.0 (33)	72.2 (42)	63.7 (36)	45.0 (25)	69.4 (40)
	Total	187.5	187.3	185.9	197.6	193.9	185.6	173.3	174.5	180.7	175.7
Low Average	N	790	238	157	178	404	449	179	210	116	385
	Regular	99.6 (41)	104.3 (42)	72.1 (32)	126.2 (53)	99.1 (41)	89.8 (40)	88.2 (42)	86.3 (39)	112.4 (54)	99.5 (46)
	Special	72.3 (30)	56.5 (23)	68.8 (30)	33.9 (14)	45.4 (19)	64.7 (29)	46.7 (22)	50.1 (22)	32.4 (16)	38.2 (18)
	Tutor/Ind.	69.8 (29)	85.3 (35)	87.1 (38)	78.9 (33)	96.3 (40)	69.8 (31)	73.3 (35)	86.9 (39)	63.2 (30)	77.5 (36)
	Total	241.9	246.2	228.2	239.2	241.2	224.6	208.7	223.3	208.1	215.3
High Average	N	473	96	134	69	151	412	111	96	35	152
	Regular	111.4 (36)	109.5 (34)	91.1 (32)	171.6 (46)	106.5 (35)	100.1 (38)	77.6 (32)	75.5 (30)	68.1 (29)	104.5 (39)
	Special	111.7 (36)	110.8 (34)	118.1 (41)	48.5 (18)	96.1 (32)	96.3 (36)	101.3 (42)	93.2 (37)	89.0 (38)	90.1 (34)
	Tutor/Ind.	83.1 (27)	104.7 (32)	78.3 (27)	131.6 (35)	98.1 (33)	69.0 (26)	65.0 (27)	83.8 (33)	77.6 (33)	70.7 (27)
	Total	306.5	325.4	288.2	351.7	300.8	265.9	244.2	252.6	234.8	265.5
High	N	292	49	59	8	89	256	54	31	10	62
	Regular	90.9 (26)	48.8 (14)	60.5 (19)	58.1 (21)	71.9 (21)	85.0 (27)	58.6 (21)	29.3 (12)	27.1 (12)	104.3 (34)
	Special	176.3 (51)	203.4 (59)	200.9 (64)	199.0 (71)	172.6 (50)	162.6 (52)	150.4 (54)	174.7 (71)	191.8 (82)	144.0 (47)
	Tutor/Ind.	80.6 (23)	90.7 (26)	54.7 (17)	24.3 (9)	98.8 (29)	64.7 (21)	70.6 (25)	38.8 (16)	15.6 (7)	56.0 (18)
	Total	348.4	342.9	316.2	281.4	343.7	312.8	279.8	244.6	234.6	304.4
		Grade 5					Grade 6				
Low	N	142	88	33	134	428	86	148	41	163	481
	Regular	88.2 (57)	80.2 (53)	114.4 (71)	121.3 (74)	103.3 (62)	70.5 (50)	93.3 (69)	76.9 (49)	104.8 (68)	96.3 (64)
	Special	19.8 (13)	16.0 (11)	12.6 (8)	2.9 (2)	5.1 (3)	14.6 (10)	8.7 (6)	20.4 (13)	3.1 (2)	8.1 (5)
	Tutor/Ind.	46.4 (30)	54.8 (36)	34.1 (21)	38.6 (24)	58.2 (35)	55.6 (39)	33.8 (25)	60.0 (38)	45.9 (30)	45.0 (30)
	Total	154.4	151.0	161.1	162.8	166.8	140.9	135.8	157.7	153.8	149.5
Low Average	N	493	180	189	83	573	432	259	185	131	661
	Regular	101.3 (48)	82.9 (39)	90.0 (44)	101.2 (52)	104.8 (50)	93.3 (47)	94.3 (51)	76.1 (39)	116.5 (57)	88.6 (47)
	Special	55.0 (26)	53.8 (25)	40.5 (20)	19.6 (10)	30.3 (14)	47.2 (24)	39.5 (22)	39.1 (20)	22.6 (11)	29.3 (16)
	Tutor/Ind.	56.2 (26)	77.3 (36)	72.9 (36)	72.8 (38)	73.7 (35)	59.2 (30)	49.2 (27)	78.6 (41)	64.0 (32)	70.6 (37)
	Total	212.6	214.3	203.5	193.7	208.9	199.8	183.0	193.9	203.2	188.6
High Average	N	372	97	117	29	128	373	97	95	24	148
	Regular	94.7 (39)	79.0 (34)	90.8 (38)	89.0 (39)	86.3 (36)	90.4 (36)	83.9 (33)	79.9 (35)	74.4 (34)	53.9 (26)
	Special	82.7 (34)	84.2 (36)	78.3 (32)	80.2 (35)	77.6 (32)	90.8 (37)	101.3 (39)	90.4 (40)	78.8 (36)	88.0 (43)
	Tutor/Ind.	66.5 (27)	69.6 (30)	72.7 (30)	57.7 (25)	77.8 (32)	67.2 (27)	71.1 (28)	56.7 (25)	65.3 (30)	64.5 (31)
	Total	244.4	233.0	242.0	226.9	241.8	248.7	256.4	227.0	218.7	206.5
High	N	218	37	46	20	58	235	35	30	33	77
	Regular	63.7 (23)	45.8 (17)	72.6 (27)	74.6 (25)	64.3 (23)	68.3 (25)	93.4 (31)	56.0 (23)	99.8 (33)	75.0 (30)
	Special	156.9 (56)	141.2 (53)	141.8 (53)	155.3 (51)	146.1 (53)	145.0 (53)	148.9 (49)	140.7 (58)	146.2 (49)	139.6 (55)
	Tutor/Ind.	58.5 (21)	81.1 (30)	54.2 (20)	72.4 (24)	65.2 (24)	58.3 (21)	58.9 (20)	46.9 (19)	53.2 (18)	38.6 (15)
	Total	279.2	268.4	268.7	302.3	275.7	271.7	301.4	243.7	299.3	253.5

*The four cost levels were obtained by collapsing the eight levels explained in Table D-4 so that every two adjacent levels form a new level. The three kinds of instruction were obtained by combining the first three, next four, and the last three instructional settings shown in Table D-4.

Table D-9

Means and Corresponding Percentages (in Parenthesis) of Standard-Resource-Dollar Costs for Reading Services Received in Three Kinds of Instruction (Regular, Special, and Tutor/Independent), by CE Categories and Four Levels of the Total Costs for Reading at Each Grade

Cost Level[a]	Kind of Instruction[a]	CE Categories: TI/TI = Title I Students; OCE/TI = Other-CE Students in Title I Schools; OCE/OCE = Other-CE Students in Other-CE Schools; NNCE/NCE = Non-CE Students Needing CE but in Schools That do not Provide it; and NNCE/CE = Non-CE Students Needing CE and Attending Schools That Provide it									
		For Grades 1, 3, and 5					For Grades 2, 4, and 6				
		TI/TI	OCE/TI	OCE/OCE	NNCE/NCE	NNCE/CE	TI/TI	OCE/TI	OCE/OCE	NNCE/NCE	NNCE/CE
		Grade 1					Grade 2				
	N	192	102	22	79	295	251	90	15	116	234
Low	Regular	89.3 (47)	99.9 (52)	88.7 (46)	118.3 (66)	126.9 (68)	74.7 (47)	97.7 (53)	80.9 (42)	112.6 (64)	112.6 (63)
	Special	65.6 (34)	63.4 (33)	52.3 (27)	22.7 (13)	25.2 (13)	47.3 (30)	43.6 (24)	65.5 (34)	17.4 (10)	28.7 (16)
	Tutor/Ind.	36.5 (19)	30.9 (16)	51.9 (27)	38.4 (21)	35.9 (19)	37.6 (24)	43.6 (24)	45.3 (24)	45.4 (26)	38.6 (22)
	Total	191.0	193.5	193.0	178.9	186.7	159.3	183.5	191.2	175.9	179.3
	N	686	250	151	137	593	748	318	188	148	459
Low Average	Regular	126.2 (38)	130.0 (40)	130.4 (42)	188.8 (63)	143.6 (45)	146.1 (44)	154.4 (50)	124.8 (38)	132.4 (42)	143.8 (47)
	Special	164.5 (50)	147.8 (45)	135.4 (43)	68.8 (23)	120.1 (38)	143.8 (43)	108.2 (35)	151.1 (46)	136.5 (44)	109.1 (36)
	Tutor/Ind.	40.9 (12)	48.4 (15)	48.3 (15)	42.5 (14)	53.8 (17)	42.3 (13)	47.4 (15)	55.2 (17)	45.0 (14)	55.4 (18)
	Total	329.9	325.7	312.6	299.3	316.3	330.7	308.5	330.0	313.4	307.2
	N	444	98	110	70	219	522	130	169	50	198
High Average	Regular	149.6 (29)	155.5 (32)	62.4 (12)	156.6 (32)	141.2 (28)	144.9 (29)	158.4 (31)	78.5 (16)	219.1 (45)	125.4 (25)
	Special	306.4 (60)	288.0 (58)	395.0 (79)	274.2 (56)	313.4 (62)	314.4 (62)	309.8 (61)	356.2 (73)	221.9 (46)	323.4 (64)
	Tutor/Ind.	53.5 (11)	50.1 (10)	45.7 (9)	55.6 (11)	51.7 (10)	45.7 (9)	41.6 (8)	57.0 (12)	45.9 (9)	60.9 (12)
	Total	507.8	492.6	502.5	485.5	505.7	503.8	508.8	491.1	484.6	508.6
	N	234	69	56	18	133	284	45	54	6	59
High	Regular	95.9 (13)	128.8 (17)	80.9 (10)	51.6 (7)	89.5 (12)	100.7 (13)	86.8 (10)	37.2 (5)	122.7 (17)	40.9 (5)
	Special	617.2 (81)	604.3 (78)	667.9 (83)	682.8 (87)	607.0 (82)	639.4 (81)	715.7 (84)	667.1 (88)	533.3 (75)	683.0 (89)
	Tutor/Ind.	50.9 (7)	39.4 (5)	56.8 (7)	48.7 (6)	40.9 (6)	46.0 (6)	51.3 (6)	55.4 (7)	58.3 (8)	47.0 (6)
	Total	763.3	772.4	804.8	782.9	737.4	785.1	855.4	760.0	713.3	770.8
		Grade 3					Grade 4				
	N	187	97	62	68	258	201	66	65	179	447
Low	Regular	75.4 (47)	98.5 (62)	84.9 (54)	112.6 (70)	101.8 (65)	70.6 (47)	81.4 (56)	85.6 (53)	108.6 (76)	93.4 (64)
	Special	57.9 (36)	28.1 (18)	31.1 (20)	16.7 (10)	20.5 (13)	49.8 (33)	22.8 (16)	41.8 (26)	11.1 (8)	18.1 (12)
	Tutor/Ind.	28.1 (17)	33.1 (21)	39.3 (25)	31.0 (19)	34.5 (22)	29.7 (20)	42.6 (29)	33.9 (21)	23.6 (16)	34.6 (24)
	Total	161.1	159.5	156.5	159.9	156.4	150.5	146.4	160.6	143.7	145.8
	N	750	238	157	178	404	449	179	210	116	385
Low Average	Regular	106.9 (37)	128.9 (43)	83.1 (29)	142.0 (49)	111.3 (39)	103.0 (35)	112.8 (43)	106.4 (39)	117.3 (45)	118.2 (45)
	Special	147.2 (51)	128.8 (43)	155.6 (55)	107.8 (37)	123.5 (43)	154.6 (53)	114.0 (43)	121.0 (44)	108.3 (42)	105.5 (40)
	Tutor/Ind.	35.9 (12)	43.6 (15)	44.6 (16)	39.7 (14)	50.9 (18)	36.7 (13)	38.6 (15)	49.7 (18)	32.4 (13)	41.5 (16)
	Total	289.1	300.0	282.5	208.3	284.8	293.3	264.3	275.6	257.9	264.0
	N	473	94	134	69	151	412	111	96	35	152
High Average	Regular	129.1 (28)	126.9 (28)	87.1 (19)	195.9 (44)	108.0 (24)	119.1 (27)	103.8 (24)	86.5 (20)	73.0 (18)	110.8 (26)
	Special	289.8 (63)	275.9 (61)	342.4 (73)	190.6 (43)	290.9 (65)	280.8 (64)	296.0 (68)	288.6 (69)	296.1 (72)	272.6 (64)
	Tutor/Ind.	45.9 (10)	52.5 (12)	40.4 (9)	61.1 (14)	51.5 (11)	38.2 (9)	34.9 (8)	47.9 (11)	41.2 (10)	41.4 (10)
	Total	463.5	454.5	469.3	445.4	449.8	437.0	433.7	422.5	410.2	424.0
	N	292	49	59	8	89	256	5[illegible]	31	10	62
High	Regular	99.5 (14)	58.1 (8)	61.5 (8)	69.2 (10)	75.4 (11)	92.7 (14)	72.2 (12)	37.5 (6)	35.3 (5)	119.3 (19)
	Special	547.4 (79)	615.2 (86)	658.9 (87)	628.2 (89)	577.9 (82)	512.1 (80)	494.6 (82)	606.1 (91)	647.6 (94)	477.3 (75)
	Tutor/Ind.	43.9 (6)	41.6 (6)	32.8 (4)	11.8 (2)	50.4 (7)	38.7 (6)	37.3 (6)	22.6 (3)	9.6 (1)	38.1 (6)
	Total	690.2	714.6	753.1	708.5	703.5	643.0	603.4	665.9	692.5	633.4
		Grade 5					Grade 6				
	N	142	80	33	134	428	86	148	41	163	481
Low	Regular	68.8 (60)	71.4 (56)	91.9 (75)	102.4 (80)	84.9 (70)	65.9 (60)	63.6 (66)	60.0 (53)	70.7 (73)	71.1 (66)
	Special	22.9 (20)	25.2 (20)	15.9 (13)	6.5 (5)	8.5 (7)	17.0 (15)	17.3 (18)	30.0 (27)	4.8 (5)	14.2 (13)
	Tutor/Ind.	22.4 (20)	31.3 (24)	14.5 (12)	19.4 (15)	28.7 (24)	27.4 (25)	15.4 (16)	22.7 (20)	21.1 (22)	21.4 (20)
	Total	114.4	128.2	122.4	128.6	122.0	109.5	96.2	112.5	97.1	106.9
	N	493	180	189	83	573	432	259	185	131	661
Low Average	Regular	98.2 (41)	94.0 (41)	108.8 (45)	113.7 (52)	112.5 (50)	97.1 (43)	91.0 (44)	88.2 (39)	110.7 (52)	93.8 (46)
	Special	111.0 (47)	94.8 (41)	92.4 (38)	59.9 (28)	76.9 (34)	97.2 (43)	89.0 (43)	94.1 (41)	65.2 (31)	71.2 (35)
	Tutor/Ind.	29.6 (12)	41.8 (18)	42.1 (17)	45.1 (21)	38.0 (17)	31.0 (14)	26.9 (13)	46.5 (20)	35.3 (17)	38.4 (19)
	Total	238.5	230.0	241.3	217.9	227.0	224.9	207.2	227.2	211.2	202.8
	N	372	97	117	29	128	373	97	95	24	148
High Average	Regular	110.7 (29)	98.7 (25)	111.8 (29)	91.4 (25)	100.8 (27)	100.8 (27)	76.8 (22)	75.2 (20)	79.3 (22)	61.2 (17)
	Special	231.0 (61)	256.1 (65)	228.3 (60)	249.5 (67)	231.2 (61)	230.6 (63)	241.8 (68)	266.6 (71)	245.4 (69)	266.8 (73)
	Tutor/Ind.	39.7 (10)	38.4 (10)	42.5 (11)	28.8 (8)	45.5 (12)	35.7 (10)	36.1 (10)	33.0 (9)	32.8 (9)	36.5 (10)
	Total	380.3	391.8	380.3	369.7	376.6	367.1	354.8	374.4	357.3	363.9
	N	218	37	46	20	58	235	35	30	33	77
High	Regular	73.1 (12)	56.6 (10)	70.2 (12)	93.7 (15)	73.5 (12)	78.7 (14)	111.0 (19)	56.4 (10)	125.5 (20)	77.9 (14)
	Special	504.3 (82)	483.1 (83)	470.4 (83)	489.0 (79)	481.6 (80)	465.8 (81)	452.9 (76)	460.2 (85)	478.6 (76)	472.8 (83)
	Tutor/Ind.	35.4 (6)	42.4 (7)	30.2 (5)	39.7 (6)	44.4 (7)	34.4 (6)	31.7 (5)	25.3 (5)	28.7 (5)	21.3 (4)
	Total	612.6	581.7	570.2	621.4	599.0	578.0	594.8	541.8	632.7	571.7

[a] The four cost levels were obtained by collapsing the eight levels explained in Table D-4 so that every two adjacent levels form a new level. The three kinds of instruction were obtained by combining the first three, next four, and the last three instructional settings shown in Table D-4.

Table D-10

Means and Corresponding Percentages (in Parenthesis) of Yearly Hours of Math Services Received in Three Kinds of Instruction (Regular, Special, and Tutor/Independent), by CE Categories and Four Levels of the Total Costs for Math Services at Each Grade

CE Categories: TI/TI = Title I Students; OCE/TI = Other-CE Students in Title I Schools; OCE/OCE = Other-CE Students in Other-CE Schools; NNCE/NCE = Non-CE Students Needing CE but in Schools That do not Provide it; and NNCE/CE = Non-CE Students Needing CE and Attending Schools That Provide it

Cost Level*	Kind of Instruction*	For Grades 1, 3, and 5					For Grades 2, 4, and 6				
		TI/TI	OCE/TI	OCE/OCE	NNCE/NCE	NNCE/CE	TI/TI	OCE/TI	OCE/OCE	NNCE/NCE	NNCE/CE
		Grade 1					Grade 2				
Low	N	62	111	8	103	202	64	82	2	94	68
	Regular	45.2 (45)	60.7 (54)	31.2 (30)	78.4 (62)	76.4 (64)	35.3 (32)	53.7 (51)	34.4 (45)	64.4 (57)	69.0 (62)
	Special	18.4 (18)	10.1 (9)	25.2 (24)	1.9 (1)	1.8 (2)	5.2 (5)	3.3 (3)	1.4 (2)	1.4 (1)	1.9 (2)
	Tutor/Ind.	37.4 (37)	41.2 (37)	46.7 (45)	47.2 (37)	42.0 (35)	68.4 (63)	48.2 (46)	40.1 (53)	47.4 (42)	41.1 (37)
	Total	101.0	111.9	103.0	127.4	120.2	109.0	105.2	75.9	113.2	112.1
Low Average	N	356	218	95	353	520	429	265	70	370	391
	Regular	70.5 (46)	74.7 (51)	80.8 (50)	104.5 (59)	83.4 (54)	85.1 (52)	67.6 (44)	93.4 (52)	110.7 (67)	87.0 (54)
	Special	35.0 (23)	19.9 (14)	25.4 (16)	13.0 (7)	12.2 (8)	22.9 (14)	17.6 (11)	16.0 (9)	7.0 (4)	11.9 (7)
	Tutor/Ind.	47.6 (31)	51.2 (35)	54.9 (34)	58.9 (33)	59.1 (38)	55.9 (34)	68.2 (44)	70.5 (39)	48.6 (29)	62.6 (39)
	Total	153.1	145.8	161.0	176.5	154.7	163.9	153.4	179.9	166.3	161.5
High Average	N	255	81	83	109	164	244	106	67	70	180
	Regular	85.4 (46)	71.7 (45)	55.5 (35)	69.3 (39)	79.0 (46)	81.4 (43)	74.0 (40)	44.9 (27)	83.8 (46)	104.5 (51)
	Special	58.3 (31)	49.9 (31)	50.5 (32)	51.9 (29)	42.4 (24)	53.2 (28)	56.5 (31)	63.5 (38)	40.4 (22)	36.8 (18)
	Tutor/Ind.	42.7 (23)	37.0 (23)	53.9 (34)	57.9 (32)	52.0 (30)	56.5 (30)	52.3 (29)	59.7 (35)	59.6 (32)	64.6 (31)
	Total	186.5	158.6	160.0	179.2	173.5	191.2	182.8	168.1	183.7	206.0
High	N	119	16	24	26	80	165	24	26	21	123
	Regular	55.8 (26)	27.6 (17)	42.7 (21)	56.0 (21)	70.3 (33)	69.5 (30)	32.0 (15)	24.8 (13)	45.2 (22)	113.2 (42)
	Special	114.2 (53)	97.2 (59)	82.1 (41)	116.2 (44)	84.2 (40)	100.6 (44)	104.6 (50)	106.8 (58)	94.2 (46)	78.4 (29)
	Tutor/Ind.	45.2 (21)	41.1 (25)	76.6 (38)	92.3 (35)	57.2 (27)	60.6 (26)	74.5 (35)	53.3 (29)	66.4 (32)	76.2 (28)
	Total	215.4	165.9	201.4	264.7	211.8	230.9	211.1	184.9	206.3	267.6
		Grade 3					Grade 4				
Low	N	77	69	20	250	302	58	48	4	123	223
	Regular	66.5 (45)	80.3 (50)	105.9 (67)	88.3 (61)	82.6 (60)	66.1 (48)	83.1 (53)	98.8 (67)	108.9 (70)	98.2 (68)
	Special	17.4 (12)	8.0 (5)	4.9 (3)	1.8 (1)	5.5 (4)	12.5 (9)	1.8 (1)	4.2 (3)	0.4 (0)	2.3 (2)
	Tutor/Ind.	65.2 (44)	71.3 (45)	46.1 (29)	54.1 (38)	50.7 (36)	59.1 (43)	72.4 (46)	44.4 (30)	46.3 (30)	44.8 (31)
	Total	149.1	159.6	157.1	144.2	138.8	137.7	157.3	147.4	155.6	145.3
Low Average	N	398	201	152	241	336	354	197	171	497	440
	Regular	78.5 (46)	88.2 (52)	77.4 (43)	99.6 (56)	92.9 (53)	85.9 (49)	91.6 (52)	75.5 (43)	104.8 (62)	98.2 (57)
	Special	39.3 (23)	26.8 (16)	24.0 (13)	12.3 (7)	18.7 (11)	36.3 (21)	20.9 (12)	27.7 (16)	11.2 (7)	18.9 (11)
	Tutor/Ind.	54.4 (32)	53.3 (32)	77.1 (43)	65.9 (37)	62.2 (36)	52.8 (30)	62.3 (36)	72.0 (41)	52.0 (31)	55.7 (32)
	Total	172.2	168.4	178.5	177.8	173.9	175.1	174.8	175.2	168.0	172.8
High Average	N	281	85	45	97	122	176	107	63	37	107
	Regular	80.2 (42)	72.6 (37)	71.5 (36)	116.4 (50)	75.2 (40)	106.0 (48)	88.7 (39)	72.5 (32)	81.6 (39)	84.7 (41)
	Special	59.4 (31)	57.8 (29)	56.8 (29)	33.5 (14)	55.5 (29)	63.1 (29)	47.7 (21)	59.4 (26)	66.5 (31)	69.5 (34)
	Tutor/Ind.	50.9 (27)	66.8 (34)	68.0 (35)	81.2 (35)	58.6 (31)	50.1 (23)	90.9 (40)	93.3 (41)	63.2 (30)	52.0 (25)
	Total	190.7	197.3	196.2	231.2	189.5	219.2	227.3	225.1	211.3	206.2
High	N	164	30	33	27	58	122	42	17	14	51
	Regular	79.7 (34)	70.4 (32)	79.4 (30)	133.1 (58)	46.8 (23)	73.7 (28)	64.8 (26)	63.4 (27)	76.8 (31)	25.0 (13)
	Special	108.7 (47)	104.8 (48)	113.6 (43)	61.7 (27)	105.7 (53)	129.8 (49)	130.5 (52)	123.6 (53)	111.[illegible] (45)	136.0 (69)
	Tutor/Ind.	43.0 (19)	43.9 (20)	71.4 (27)	33.0 (14)	47.6 (24)	61.8 (23)	53.5 (21)	45.0 (19)	60.9 (24)	34.9 (18)
	Total	231.4	219.2	264.5	227.8	200.2	265.4	249.2	232.3	248.8	196.1
		Grade 5					Grade 6				
Low	N	58	49	16	207	27	56	56	6	65	222
	Regular	96.2 (78)	132.2 (83)	118.4 (82)	117.0 (78)	99.[illegible] (67)	93.8 (81)	83.1 (60)	99.7 (79)	90.7 (56)	89.3 (68)
	Special	6.7 (5)	1.9 (1)	9.9 (7)	0.6 (0)	2.[illegible] (2)	4.0 (3)	3.1 (2)	3.0 (2)	0.5 (0)	1.7 (1)
	Tutor/Ind.	21.0 (17)	24.8 (16)	17.0 (12)	33.3 (22)	45.2 (31)	18.2 (16)	51.3 (37)	[illegible]1.2 (19)	46.4 (34)	40.4 (31)
	Total	123.9	158.9	145.3	150.9	14[illegible].1	116.1	137.5	127.0	137.6	131.4
Low Average	N	313	179	164	391	503	275	380	144	477	671
	Regular	95.8 (53)	87.4 (52)	75.8 (44)	102.9 (63)	106.5 (59)	83.6 (51)	75.0 (49)	71.9 (41)	114.9 (69)	104.1 (63)
	Special	42.5 (23)	27.1 (16)	28.7 (17)	14.6 (9)	19.4 (11)	33.0 (20)	23.0 (15)	31.6 (18)	11.7 (7)	12.4 (8)
	Tutor/Ind.	43.3 (24)	53.0 (32)	67.1 (39)	45.6 (28)	54.8 (30)	48.0 (29)	55.4 (36)	70.0 (40)	38.8 (23)	48.4 (29)
	Total	181.7	167.5	171.6	163.3	180.7	164.7	153.4	173.6	165.4	165.0
High Average	N	204	102	52	88	121	156	77	82	143	129
	Regular	80.7 (39)	66.9 (32)	54.2 (30)	40.2 (22)	65.3 (35)	66.0 (34)	39.7 (22)	75.3 (41)	84.2 (44)	91.0 (51)
	Special	74.8 (36)	55.4 (26)	70.4 (39)	64.1 (36)	64.2 (34)	76.7 (40)	70.3 (39)	52.9 (29)	52.7 (28)	50.2 (28)
	Tutor/Ind.	53.4 (26)	89.1 (42)	55.5 (31)	74.4 (42)	56.5 (30)	48.6 (25)	69.3 (39)	55.1 (30)	53.6 (28)	36.9 (21)
	Total	209.0	211.6	180.1	178.8	186.5	191.8	179.9	183.6	190.4	178.1
High	N	141	20	14	37	39	155	36	14	54	39
	Regular	96.5 (36)	38.3 (19)	22.0 (11)	34.2 (17)	86.5 (31)	103.9 (41)	51.3 (26)	35.6 (21)	125.0 (49)	56.2 (29)
	Special	133.4 (49)	133.1 (66)	136.1 (68)	127.5 (62)	133.2 (48)	120.0 (47)	116.0 (58)	105.3 (61)	95.3 (37)	102.2 (52)
	Tutor/Ind.	39.8 (15)	30.7 (15)	42.3 (21)	43.9 (21)	57.3 (21)	30.7 (12)	32.1 (16)	31.4 (18)	34.2 (13)	37.4 (19)
	Total	269.6	202.1	200.4	205.7	277.9	254.7	199.4	172.3	254.6	195.8

*The four cost levels were obtained by collapsing the eight levels explained in Table D-6 so that every two adjacent levels form a new level. The three kinds of instruction were obtained by combining the first three, next four, and the last three instructional settings shown in Table D-6.

Table D-11

Means and Corresponding Percentages (in Parentheses) of Standard-Resource-Dollar Costs for Math Services Received in Three Kinds of Instruction (Regular, Special, and Tutor/Independent), by CE Categories and Four Levels of the Total Costs for Math at Each Grade

Cost Level*	Kind of Instruction*	CE Categories: TI/TI = Title I Students; OCE/TI = Other-CE Students in Title I Schools; OCE/OCE = Other CE-Students in Other-CE Schools; NNCE/NCE = Non-CE Students Needing CE but in Schools That do not Provide it; and NNCE/CE = Non-CE Students Needing CE and Attending Schools That Provide it									
		For Grades 1, 3, and 5					For Grades 2, 4, and 6				
		TI/TI	OCE/TI	OCE/OCE	NNCE/NCE	NNCE/CE	TI/TI	OCE/TI	OCE/OCE	NNCE/NCE	NNCE/CE
		Grade 1					Grade 2				
	N	42	111	8	103	202	64	82	2	94	68
Low	Regular	28.3 (42)	35.5 (52)	17.8 (24)	47.7 (67)	47.4 (65)	23.2 (37)	36.5 (56)	37.0 (59)	38.6 (62)	44.1 (66)
	Special	23.1 (35)	13.0 (19)	35.7 (48)	1.8 (3)	5.2 (7)	9.2 (15)	5.0 (8)	4.6 (7)	3.1 (5)	3.2 (5)
	Tutor/Ind.	15.4 (23)	19.5 (29)	20.9 (28)	21.6 (30)	20.1 (28)	30.8 (49)	24.1 (37)	20.9 (33)	20.4 (33)	19.2 (29)
	Total	66.8	68.0	74.5	71.1	72.7	63.2	65.6	62.5	62.1	66.6
	N	356	218	95	353	520	429	265	70	370	391
Low Average	Regular	62.6 (45)	68.6 (51)	59.7 (43)	74.1 (59)	69.0 (54)	69.0 (53)	61.7 (49)	68.1 (51)	82.8 (67)	66.7 (55)
	Special	53.8 (39)	39.4 (29)	51.2 (37)	24.3 (19)	30.4 (24)	33.0 (25)	29.8 (24)	30.7 (23)	17.0 (14)	25.0 (21)
	Tutor/Ind.	23.2 (17)	27.0 (20)	26.4 (19)	26.7 (21)	28.4 (22)	27.7 (21)	34.0 (27)	34.7 (26)	22.9 (19)	29.9 (25)
	Total	139.6	135.0	137.3	125.1	127.8	129.7	125.4	133.5	122.8	121.7
	N	255	81	83	109	164	244	106	67	70	180
High Average	Regular	91.4 (40)	72.1 (33)	66.9 (29)	58.6 (27)	74.5 (33)	80.9 (35)	77.8 (36)	53.8 (23)	84.3 (37)	91.9 (40)
	Special	113.1 (50)	12[illegible].9 (59)	128.9 (56)	130.8 (61)	124.9 (56)	121.5 (53)	111.8 (52)	149.3 (64)	113.9 (51)	104.3 (46)
	Tutor/Ind.	21.8 (10)	16.5 (8)	32.3 (14)	26.6 (12)	24.5 (11)	28.4 (12)	27.2 (13)	30.2 (13)	26.7 (12)	31.3 (14)
	Total	226.3	220.5	228.2	215.9	223.9	230.8	216.8	233.3	224.9	227.5
	N	119	16	24	26	80	165	24	26	21	123
High	Regular	61.5 (16)	25.1 (7)	49.0 (13)	42.6 (11)	75.7 (22)	68.1 (18)	32.4 (8)	20.5 (6)	43.6 (12)	115.9 (30)
	Special	305.2 (78)	320.9 (88)	273.9 (74)	316.2 (80)	246.5 (71)	287.8 (75)	328.1 (83)	292.5 (86)	304.0 (80)	240.9 (62)
	Tutor/Ind.	23.8 (6)	20.2 (6)	45.2 (12)	35.4 (9)	24.9 (7)	27.8 (7)	37.0 (9)	26.2 (8)	31.1 (8)	32.1 (8)
	Total	390.6	366.2	368.1	394.3	347.1	383.7	397.4	339.3	378.7	388.8
		Grade 3					Grade 4				
	N	77	69	20	250	302	58	48	4	123	223
Low	Regular	45.1 (47)	54.2 (57)	68.[illegible] (70)	55.6 (65)	53.3 (63)	43.4 (52)	50.8 (60)	58.5 (72)	64.2 (75)	57.4 (72)
	Special	20.6 (21)	11.0 (12)	8.8 (9)	4.8 (6)	9.1 (11)	13.3 (16)	4.1 (5)	3.6 (4)	1.2 (1)	3.3 (4)
	Tutor/Ind.	30.6 (32)	30.1 (32)	20.4 (21)	24.7 (29)	22.0 (26)	26.2 (32)	29.5 (35)	19.1 (24)	20.1 (24)	19.2 (24)
	Total	96.4	95.2	97.2	85.1	84.4	83.0	84.5	81.2	85.5	79.9
	N	398	201	152	241	336	354	197	171	497	440
Low Average	Regular	63.8 (39)	71.8 (47)	61.5 (41)	81.6 (54)	79.9 (53)	71.2 (43)	81.9 (50)	61.0 (39)	88.0 (61)	84.5 (55)
	Special	73.9 (45)	57.8 (37)	51.7 (34)	37.6 (25)	43.0 (28)	68.8 (42)	50.2 (30)	60.1 (38)	31.4 (22)	44.1 (28)
	Tutor/Ind.	26.6 (16)	24.8 (16)	36.7 (24)	32.0 (21)	29.0 (19)	25.4 (15)	32.6 (20)	37.0 (23)	24.9 (17)	26.0 (17)
	Total	164.4	154.5	150.0	151.2	151.9	165.4	164.7	158.2	144.3	154.6
	N	281	85	45	97	122	176	107	63	37	107
High Average	Regular	81.6 (32)	70.1 (28)	59.9 (23)	115.2 (45)	71.0 (27)	92.1 (31)	106.5 (36)	74.3 (26)	79.9 (26)	82.4 (27)
	Special	143.6 (57)	150.7 (60)	160.9 (63)	102.5 (40)	159.8 (62)	181.7 (60)	143.7 (49)	158.3 (55)	194.1 (64)	194.3 (64)
	Tutor/Ind.	25.9 (10)	32.3 (13)	34.1 (13)	37.4 (15)	28.7 (11)	27.9 (9)	43.8 (15)	55.1 (19)	29.6 (10)	27.3 (9)
	Total	251.2	253.1	254.8	255.1	259.6	301.7	294.0	287.8	303.6	304.0
	N	164	30	33	27	58	122	42	17	14	51
High	Regular	72.2 (18)	64.0 (15)	62.1 (16)	151.9 (41)	45.7 (11)	73.1 (14)	67.1 (13)	58.6 (12)	79.4 (17)	23.9 (5)
	Special	312.3 (77)	345.4 (80)	295.8 (75)	205.6 (55)	346.9 (83)	419.4 (79)	422.4 (82)	401.2 (83)	358.0 (77)	440.9 (91)
	Tutor/Ind.	22.5 (6)	24.9 (6)	34.8 (9)	16.7 (4)	23.5 (6)	36.5 (7)	25.3 (5)	23.4 (5)	28.6 (6)	19.5 (4)
	Total	407.0	434.3	392.7	374.3	416.1	529.0	514.8	483.2	466.0	484.3
		Grade 5					Grade 6				
	N	58	49	16	207	273	56	56	6	65	222
Low	Regular	51.5 (79)	63.5 (83)	69.1 (79)	69.3 (81)	59.4 (72)	54.1 (85)	42.0 (62)	58.6 (82)	49.7 (73)	50.3 (73)
	Special	5.6 (9)	3.2 (4)	11.0 (13)	1.9 (2)	4.1 (5)	3.4 (5)	5.5 (8)	1.7 (2)	0.8 (1)	2.7 (4)
	Tutor/Ind.	7.9 (12)	9.6 (13)	6.8 (8)	14.5 (17)	18.9 (23)	6.1 (10)	20.2 (30)	11.1 (16)	17.2 (25)	16.3 (23)
	Total	65.0	76.3	86.9	85.7	82.4	63.7	67.7	71.5	67.7	69.4
	N	313	179	164	391	503	275	380	144	477	671
Low Average	Regular	76.8 (47)	76.5 (46)	74.2 (44)	83.2 (60)	83.6 (57)	68.0 (48)	59.6 (41)	54.1 (37)	87.2 (66)	77.5 (61)
	Special	65.[illegible] (40)	62.8 (38)	58.3 (35)	35.3 (25)	38.2 (26)	52.1 (36)	59.5 (41)	5[illegible].6 (40)	27.5 (21)	26.2 (21)
	Tutor/Ind.	21.5 (13)	25.8 (16)	35.9 (21)	21.1 (15)	25.3 (17)	23.0 (16)	26.7 (18)	32.7 (22)	17.5 (13)	22.8 (18)
	Total	164.0	165.2	168.4	139.6	147.2	143.2	145.8	145.4	132.1	126.5
	N	204	102	52	88	121	156	77	82	143	129
High Average	Regular	74.6 (25)	77.4 (28)	49.3 (17)	41.2 (14)	62.7 (22)	65.7 (25)	43.7 (16)	83.0 (34)	78.7 (30)	92.8 (35)
	Special	191.1 (65)	158.2 (57)	205.0 (72)	206.8 (72)	190.4 (68)	167.0 (65)	190.4 (71)	126.4 (52)	153.5 (59)	153.9 (58)
	Tutor/Ind.	29.3 (10)	42.0 (15)	29.9 (11)	39.4 (14)	28.2 (10)	25.0 (10)	35.2 (13)	33.1 (14)	26.7 (10)	19.5 (7)
	Total	29[illegible].0	277.7	284.3	287.3	281.3	257.7	269.3	242.6	258.9	266.1
	N	141	20	14	37	39	155	36	14	54	39
High	Regular	90.9 (18)	38.9 (8)	18.9 (4)	40.4 (9)	85.9 (17)	118.5 (26)	51.6 (13)	39.1 (10)	153.4 (32)	62.5 (15)
	Special	390.8 (78)	432.9 (89)	419.7 (91)	403.6 (87)	385.3 (76)	329.0 (71)	339.7 (84)	335.5 (86)	310.1 (65)	321.6 (80)
	Tutor/Ind.	22.3 (4)	14.1 (3)	21.4 (5)	20.5 (4)	36.4 (7)	15.6 (3)	14.9 (4)	14.9 (4)	14.7 (3)	20.3 (5)
	Total	503.9	485.9	460.0	464.5	507.6	463.2	406.2	389.6	478.3	404.5

*The four cost levels were obtained by collapsing the eight levels explained in Table D-6 so that every two adjacent levels form a new level. The three kinds of instruction were obtained by combining the first three, next four, and the last three instructional settings shown in Table D-6.

Table D-12

Analysis of Variance of Reading Achievement Growth by CE Status (CE Students vs. Two Comparison Groups of Non-CE Students), and Two Factors Nested Within the CE Group: Four Levels of the Standard-Resource-Dollar Costs for Reading Services and Three CE Categories

A: Treatment	CE Students												Needy Non-CE Students in		ANOVA Test Statistics***				
B(A): CE Group	Title I Students in Title I Schools				Other-CE Students in Title I Schools				CE Students in Other-CE Schools				Non-CE Schools	CE Schools	Test I	Test II	Test III	Test IV	Test V
C(A): Cost Level**	Low	Low Average	High Average	High	Low	Low Average	High Average	High	Low	Low Average	High Average	High							
	Sample Sizes (First Row for Each Grade, Omitted in Three Lower Sections) and Mean Gains in Terms of Standardized (z) Scores																		
Gr. 1	192	686	444	234	102	250	98	69	22	151	110	56	304	1,240					
	-0.01	0.03	0.11	0.04	-0.06	-0.14	-0.03	-0.23	0.06	-0.19	-0.15	-0.29	-0.07	-0.07	2.02	0.00	8.62*	1.96	0.84
Gr. 2	251	748	522	284	90	318	130	45	15	188	169	54	320	950					
	0.02	0.10	0.03	0.03	-0.11	-0.02	0.01	-0.06	-0.11	0.16	0.09	0.03	-0.01	0.02	1.33	0.22	2.89	2.18	0.63
Gr. 3	187	750	473	292	97	238	94	49	62	157	134	59	323	902					
	0.05	0.07	0.09	0.08	-0.06	-0.03	0.03	0.23	-0.05	0.03	0.12	-0.16	0.04	0.04	0.16	0.07	3.09	2.18	2.94*
Gr. 4	201	449	412	256	66	179	111	54	65	210	96	31	340	1,046					
	0.03	-0.02	0.07	0.06	-0.06	-0.00	0.01	0.06	0.10	-0.01	-0.08	-0.05	0.02	0.01	0.17	[illegible]	0.82	0.35	1.37
Gr. 5	142	493	372	218	80	180	97	37	33	189	117	46	266	1,187					
	0.03	-0.00	0.04	0.01	-0.09	-0.03	-0.00	-0.09	-0.04	0.05	0.04	0.05	0.01	-0.00	0.21	0.06	2.68	0.62	0.49
Gr. 6	86	432	373	235	148	259	97	35	41	185	95	30	351	1,367					
	0.03	-0.00	0.08	0.12	-0.02	0.00	0.03	0.09	-0.17	-0.04	-0.03	-0.02	0.01	0.00	1.17	0.14	5.81*	2.45	0.66
	Mean Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending Non-CE Schools*																		
Gr. 1	0.45	6.65	10.06	6.10	-1.46	-3.06	1.46	-9.59	1.39	-6.04	-2.20	-10.59	0.43	3.84	1.19	4.92*	15.07*	2.73	1.20
Gr. 2	-1.37	2.38	-1.10	-4.09	-1.86	-1.22	1.50	-8.18	-1.87	6.10	1.23	-4.03	-3.17	1.02	1.89	2.14	0.45	3.30	0.61
Gr. 3	-2.54	-0.96	0.82	-2.60	-6.27	-5.95	-4.35	1.17	-6.52	-4.72	3.15	-16.71	-1.27	2.78	9.16*	13.06*	3.96	2.72	2.54
Gr. 4	-1.50	-2.09	2.50	1.52	-3.51	-3.92	-3.82	-1.81	5.18	-4.35	-5.87	-6.06	0.63	1.78	2.81	3.41	1.69	0.67	1.16
Gr. 5	9.20	9.77	17.54	12.89	1.74	7.00	8.43	3.89	9.02	15.13	11.30	17.20	0.76	5.72	16.35*	8.84*	4.68*	1.07	1.13
Gr. 6	-3.53	-6.67	-1.72	0.34	-0.73	3.07	-2.62	1.85	-17.20	-9.30	-11.02	-10.85	-6.21	-5.94	1.17	0.11	7.60*	0.55	0.80
	Mean Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending CE Schools																		
Gr. 1	-3.15	3.46	8.18	4.95	-0.81	-6.39	-0.09	-7.00	2.54	-6.84	-2.08	-11.51	-2.75	0.30	1.67	1.38	8.98*	2.70	1.82
Gr. 2	-3.66	1.30	-2.26	-3.52	-3.02	-1.54	1.65	-6.48	-4.43	5.99	2.08	-2.13	-0.35	3.02	4.13	4.13	0.42	2.34	0.66
Gr. 3	-0.10	0.81	3.05	0.07	-8.41	-4.99	-3.63	4.81	-5.84	-2.29	5.59	-13.43	0.50	3.66	5.77*	9.62*	5.02*	2.98	2.89*
Gr. 4	-0.33	0.69	4.54	4.13	-4.23	-2.76	-4.60	-1.06	5.95	1.34	-3.25	-0.49	-1.15	3.81	3.51	4.42	3.17	0.18	1.08
Gr. 5	3.20	-1.64	1.57	-1.98	-6.27	-1.63	-2.93	-12.79	-7.30	5.94	-1.42	0.27	-3.24	2.13	3.78	5.54*	3.78	1.76	1.99
Gr. 6	2.24	2.37	9.16	11.79	0.86	0.20	4.64	10.49	-11.82	1.06	-0.22	0.89	2.97	2.96	0.42	0.03	5.41*	3.33	1.01
	Mean Gains in Terms of VSS Scores																		
Gr. 1	58.83	60.29	64.82	60.12	59.59	57.21	59.61	47.78	60.50	53.85	54.84	46.93	53.50	54.92	8.47*	1.68	5.48*	3.05	1.05
Gr. 2	43.26	46.93	43.11	41.83	38.47	42.09	44.38	38.64	38.53	50.37	46.27	42.83	40.37	43.02	2.12	0.79	1.07	2.08	0.53
Gr. 3	34.78	34.31	36.76	35.29	26.92	28.91	32.05	43.18	28.94	33.39	40.30	22.19	33.81	34.14	0.01	0.30	2.53	2.47	3.11*
Gr. 4	31.31	28.10	34.73	33.61	25.55	30.08	29.36	33.33	36.71	28.50	23.82	23.45	30.75	29.88	0.18	0.08	1.43	0.27	1.88
Gr. 5	28.94	25.19	28.09	25.83	19.33	24.07	24.93	17.97	21.58	30.26	27.41	31.28	24.48	25.07	0.64	0.09	2.82	0.48	0.91
Gr. 6	26.73	23.45	29.77	32.43	25.15	24.68	26.48	31.37	11.76	21.61	22.12	23.27	24.98	24.28	0.88	0.11	4.88*	1.93	0.77

[*] F ratio is significant at the .01 level.

[**] The four cost levels are defined in terms of the mean and standard deviation (s.d.) of the total resource costs of reading services for all CE students within each grade as follows: Low = one or more s.d. below the mean; Low Average = zero to one s.d. below the mean; High Average = zero to one s.d. above the mean; and High = one or more s.d. above the mean. The lower end point of each level is excluded from that level.

[***] The five ANOVA tests of effects are: I = Effect of A; II = A|B(A),C(A),B(A)*C(A); III = B(A)|A,C(A),B(A)*C(A); IV = C(A)|A,B(A),B(A)*C(A); and V = B(A)*C(A)|A,B(A),C(A), where the symbol '|' represents 'conditional on the presence of the effects followed'.

Table D-13

Analysis of Variance of Math Achievement Growth by CE Status (CE Students vs. Two Comparison Groups of Non-CE Students), and Two Factors Nested Within the CE Group: Four Levels of the Standard-Resource-Dollar Costs for Math Services and Three CE Categories

A: Treatment	CE Students												Needy Non-CE Students in		ANOVA Test Statistics***				
B(A): CE Group	Title I Students in Title I Schools				Other-CE Students in Title I Schools				CE Students in Other-CE Schools				Non-CE Schools	CE Schools	Test I	Test II	Test III	Test IV	Test V
C(A): Cost Level**	Low	Low Average	High Average	High	Low	Low Average	High Average	High	Low	Low Average	High Average	High							
Sample Sizes (First Row for Each Grade, Omitted in Three Lower Sections) and Mean Gains in Terms of Standardized (z) Scores																			
Gr. 1	42	356	255	119	111	218	81	16	8	95	83	24	591	966					
	-0.01	-0.19	0.04	0.08	-0.27	-0.17	0.20	0.24	-0.16	-0.09	0.02	0.34	-0.14	-0.01	8.15*	6.37*	0.49	3.32	3.84*
Gr. 2	64	429	244	165	82	265	106	24	2	70	67	26	555	762					
	-0.11	0.07	0.03	-0.01	-0.05	-0.05	-0.11	-0.22	0.64	-0.14	0.06	-0.06	-0.02	0.02	0.44	0.39	1.98	0.73	1.13
Gr. 3	77	398	281	164	69	201	85	30	20	152	45	33	615	818					
	0.02	0.14	0.17	0.12	0.14	-0.05	0.06	-0.03	0.03	-0.02	0.00	-0.62	-0.05	-0.04	8.71*	0.76	8.06*	3.68	3.57*
Gr. 4	58	354	176	122	48	197	107	42	4	171	63	17	671	821					
	-0.04	-0.04	0.16	0.32	-0.14	-0.01	0.04	0.02	-1.14	-0.08	-0.60	0.16	-0.02	0.00	0.15	3.68	14.44*	8.56*	8.56*
Gr. 5	58	313	204	141	49	179	102	20	16	164	52	14	723	936					
	-0.01	0.17	0.08	0.13	-0.12	-0.04	-0.02	0.00	-0.05	-0.01	0.11	0.04	0.02	0.04	0.83	0.38	3.46	0.85	0.63
Gr. 6	56	275	156	155	56	380	77	36	6	144	82	14	739	1,061					
	-0.18	0.12	0.11	0.24	0.04	-0.01	-0.04	0.03	0.05	0.03	-0.23	0.16	-0.03	-0.02	4.34	1.05	1.14	3.09	2.92*
Mean Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending Non-CE Schools																			
Gr. 1	6.81	12.48	13.35	7.97	-6.23	2.39	8.70	-3.68	-8.74	2.37	7.35	12.40	0.65	4.44	8.39*	2.52	5.44*	2.36	0.76
Gr. 2	-1.87	3.27	0.56	1.67	-2.58	1.69	1.52	-13.99	53.31	-9.43	7.24	-0.34	-2.55	1.91	2.64	3.13	2.81	2.54	2.67
Gr. 3	2.72	14.87	18.57	17.22	3.24	-3.87	-3.01	-7.84	-7.90	3.59	10.51	-15.17	-0.07	2.60	13.63*	1.09	20.51*	2.78	2.91*
Gr. 4	-5.54	-7.72	9.30	19.09	-2.03	0.98	2.11	-10.65	-59.81	-3.11	-44.40	1.91	-1.38	1.14	1.47	6.03*	11.71*	5.39*	13.96*
Gr. 5	4.18	8.49	8.33	8.51	-5.37	1.92	-1.11	-21.42	-9.76	0.65	2.21	-10.00	0.21	6.61	4.45	7.01*	8.34*	2.02	0.85
Gr. 6	-13.13	12.80	9.67	19.31	1.89	1.07	-4.19	5.43	-8.96	2.12	-14.63	-0.56	-0.43	4.65	3.62	2.98	3.06	3.34	2.19
Mean Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending CE Schools																			
Gr. 1	1.27	5.62	6.15	0.20	-10.04	-3.43	5.22	-9.97	-9.31	-2.58	4.58	9.12	-3.79	-0.15	5.24*	2.30	3.30	2.66	1.16
Gr. 2	-9.54	-0.69	-6.23	-4.00	-5.42	-2.28	1.30	-14.44	47.29	-11.91	7.21	-2.58	0.64	4.82	10.84*	2.55	2.13	2.51	3.10*
Gr. 3	-11.63	-1.72	1.09	-0.07	-1.71	-8.81	-9.21	-20.65	-11.73	-4.85	-7.32	-39.00	-7.77	-7.83	2.68	0.56	8.10*	5.79*	4.90*
Gr. 4	-8.36	-12.91	1.09	10.54	-4.56	-1.42	-1.07	-8.99	-63.63	-8.91	-45.70	-3.66	-11.33	-9.14	2.54	0.83	9.34*	4.88*	10.01*
Gr. 5	-1.56	6.18	5.83	7.12	-11.92	-1.80	-2.57	-21.72	-11.21	-0.37	0.73	-9.20	-1.41	3.71	2.79	5.22*	7.54*	2.09	0.66
Gr. 6	-10.33	11.67	11.64	21.73	-0.90	-0.80	-1.60	4.66	-9.36	3.18	-13.51	2.58	-6.14	-0.67	14.71*	4.84*	4.24	2.44	2.03
Mean Gains in Terms of VSS Scores																			
Gr. 1	57.79	65.47	59.59	57.55	51.27	54.80	65.42	61.31	50.50	54.42	61.90	68.75	49.34	54.05	18.76*	9.34*	0.18	1.61	2.50
Gr. 2	46.69	56.26	51.99	51.35	52.38	52.67	50.43	43.29	103.00	44.34	57.43	51.15	48.55	51.91	2.36	2.49	1.70	1.34	1.95
Gr. 3	49.08	55.47	58.26	56.54	59.45	49.83	51.67	40.97	52.80	56.07	52.31	15.27	50.59	48.86	4.41	0.33	4.56	6.24*	5.08*
Gr. 4	46.83	44.57	57.95	68.63	44.94	50.78	52.95	46.74	-26.00	43.15	9.41	55.82	46.45	48.55	0.52	3.28	13.43*	6.76*	8.95*
Gr. 5	43.28	49.50	43.18	45.69	32.43	38.96	37.49	30.85	35.50	38.63	47.77	37.00	38.98	41.32	1.68	0.56	3.83	0.59	0.65
Gr. 6	27.63	45.77	44.63	54.97	40.86	38.94	37.52	45.14	41.83	39.73	20.44	46.71	34.40	36.21	6.96*	2.19	0.62	2.87	2.03

[*] F ratio is significant at the .01 level.

[**] The four cost levels are defined in terms of the mean and standard deviation (s.d.) of the total resource costs of math services for all CE Students within each grade as follows: Low = one or more s.d. below the mean; Low Average = zero to one s.d. below the mean; High average = zero to one s.d. above the mean; and High = one or more s.d. above the mean. The lower end point of each level is excluded from that level.

[***] The five ANOVA tests of effects are: I = Effect of A; II = A|B(A),C(A),B(A)*C(A); III = B(A)|A,C(A),B(A)*C(A); IV = C(A)|A,B(A),B(A)*C(A); and V = B(A)*C(A)|A,B(A),C(A), where the symbol '|' represents 'conditional on the presence of the effects followed'.

Table D-14

Mean Reading Achievement Growth in Terms of Standardized (z) Scores for Subgroups of CE Students Classified by Their Characteristics and by Four Levels of Standard-Dollar-Resource Cost in Reading

GRADE	Cost Level (B)*	Student Characteristics (A_i)																					
		Race/Ethnicity (A_1)				Free Meals-Program (A_2)				Need for CE (A_3)				Pretest Achievement Quartile (A_4)									
		White		Minority		Participant		Non-Partic.		Need		No Need		Lowest		Second		Third		Highest		Total	
		N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
	Low	149	-0.15	167	0.09	198	0.01	118	-0.09	166	-0.07	150	0.02	127	0.20	98	-0.04	39	-0.06	52	-0.53	316	-0.03
	Low-Average	541	-0.21	546	0.13	614	0.01	473	-0.10	699	0.00	388	-0.11	422	0.26	367	-0.11	173	-0.21	125	-0.59	1,087	-0.04
1	High-Average	324	-0.12	328	0.21	397	0.16	255	-0.13	462	0.04	190	0.04	310	0.36	173	-0.02	85	-0.39	84	-0.58	652	0.04
	High	260	-0.11	99	0.05	197	-0.01	162	-0.12	299	-0.08	60	0.02	169	0.26	125	-0.23	50	-0.54	15	-0.68	359	-0.06
	Total	1,274	-0.16	1,140	0.14	1,406	0.05	1,008	-0.11	1,626	-0.01	788	-0.04	1,028	0.28	763	-0.10	347	-0.29	276	-0.58	2,414	-0.02
	F-Tests for:																						
	$B \mid A_i, A_i \times B$	1.42				0.89				1.57				2.05									
	$A_i \times B \mid A_i, B$	1.09				1.78				1.71				1.70									
	Low	177	0.01	179	-0.05	234	-0.00	122	-0.05	190	0.02	166	-0.06	148	0.24	89	-0.13	61	-0.19	58	-0.32	356	-0.02
	Low-Average	749	0.10	505	0.04	663	0.03	591	0.13	889	0.10	365	0.02	606	0.24	394	-0.03	171	-0.05	83	-0.32	1,254	0.08
2	High-Average	462	0.06	359	0.00	439	0.01	382	0.07	676	0.04	145	0.05	422	0.24	270	-0.14	96	-0.18	33	-0.42	821	0.04
	High	253	0.07	130	-0.07	178	-0.03	205	0.06	349	0.04	34	-0.18	209	0.19	146	-0.17	23	-0.18	5	-0.24	383	0.02
	Total	1,641	0.08	1,173	0.01	1,514	0.01	1,300	0.09	2,104	0.06	710	-0.00	1,385	0.23	899	-0.10	351	-0.12	179	-0.34	2,814	0.05
	F-Tests for:																						
	$B \mid A_i, A_i \times B$	2.34				2.63				2.39				1.63									
	$A_i \times B \mid A_i, B$	0.40				1.07				1.16				0.70									
	Low	198	0.01	148	-0.01	192	-0.02	154	0.02	183	0.03	163	-0.04	150	0.08	113	-0.01	62	-0.11	21	-0.25	346	-0.00
	Low-Average	610	0.01	535	0.08	696	0.07	449	-0.01	830	0.07	315	-0.04	631	0.16	308	-0.03	122	-0.15	84	-0.30	1,145	0.04
3	High-Average	382	0.09	319	0.08	399	0.08	302	0.10	613	0.09	88	0.07	414	0.20	207	-0.04	64	-0.12	16	-0.27	701	0.09
	High	236	0.04	164	0.09	208	0.09	192	0.03	377	0.05	23	0.24	270	0.19	99	-0.11	29	-0.43	2	-1.23	400	0.06
	Total	1,426	0.04	1,166	0.07	1,495	0.06	1,097	0.03	2,003	0.07	589	-0.02	1,465	0.17	727	-0.04	277	-0.17	123	-0.30	2,592	0.05
	F-Tests for:																						
	$B \mid A_i, A_i \times B$	2.28				2.46				2.84				3.46									
	$A_i \times B \mid A_i, B$	1.02				1.52				2.37				2.12									
	Low	215	0.06	117	-0.03	170	-0.01	162	0.06	191	0.05	141	-0.00	168	0.10	76	0.01	50	-0.06	38	-0.17	332	0.03
	Low-Average	463	-0.00	375	-0.03	473	-0.02	365	-0.01	592	-0.00	246	-0.05	468	0.03	229	-0.04	96	-0.09	45	-0.18	838	-0.01
4	High-Average	348	0.03	271	0.05	352	0.04	267	0.03	545	0.03	74	0.08	420	0.08	146	-0.05	43	-0.14	10	0.23	619	0.04
	High	178	-0.03	163	0.13	216	0.06	125	0.03	310	0.04	31	0.14	225	0.15	88	-0.14	26	-0.15	2	-0.18	341	0.05
	Total	1,204	0.01	926	0.02	1,211	0.02	919	0.02	1,638	0.02	492	-0.00	1,281	0.08	539	-0.05	215	-0.10	95	-0.13	2,130	0.02
	F-Tests for:																						
	$B \mid A_i, A_i \times B$	1.68				1.35				2.13				1.10									
	$A_i \times B \mid A_i, B$	3.13				0.53				0.87				1.40									
	Low	179	0.02	76	-0.10	115	-0.10	140	0.05	165	-0.02	90	-0.01	114	0.08	73	-0.10	42	-0.13	26	-0.02	255	-0.02
	Low-Average	431	-0.02	431	0.02	531	-0.00	331	0.01	690	0.01	172	-0.03	497	0.06	250	-0.07	80	-0.11	35	-0.00	862	0.00
5	High-Average	278	0.05	308	0.02	366	0.03	220	0.03	525	0.03	61	-0.00	390	0.07	153	-0.03	35	-0.06	8	-0.29	586	0.03
	High	137	0.03	164	-0.01	204	-0.05	97	0.12	278	0.01	23	-0.08	228	0.06	64	-0.16	8	-0.14	1	-0.06	301	0.00
	Total	1,025	0.01	979	0.00	1,216	-0.01	788	0.04	1,658	0.01	346	-0.02	1,229	0.06	540	-0.07	165	-0.11	70	-0.04	2,004	0.01
	F-Tests for:																						
	$B \mid A_i, A_i \times B$	1.22				1.05				0.29				0.27									
	$A_i \times B \mid A_i, B$	1.70				3.31				0.33				0.58									
	Low	225	-0.02	50	-0.08	102	-0.07	173	0.00	148	-0.02	127	-0.04	108	0.06	81	-0.10	49	-0.08	37	-0.04	275	-0.03
	Low-Average	405	0.01	471	-0.03	529	-0.02	347	0.00	632	0.00	244	-0.03	505	0.03	243	-0.03	88	-0.09	40	-0.19	876	-0.01
6	High-Average	240	0.04	325	0.06	358	0.05	207	0.06	478	0.03	87	0.14	402	0.09	139	-0.04	19	-0.00	5	-0.25	565	0.05
	High	138	0.06	162	0.14	202	0.12	98	0.07	276	0.10	24	0.16	209	0.13	86	0.05	5	-0.03	(0)	—	300	0.10
	Total	1,008	0.02	1,008	0.02	1,191	0.02	825	0.02	1,534	0.03	482	0.01	1,224	0.07	549	-0.03	161	-0.07	82	-0.13	2,016	0.02
	F-Tests for:																						
	$B \mid A_i, A_i \times B$	5.88**				5.32**				6.08**				0.84†									
	$A_i \times B \mid A_i, B$	1.59				0.74				1.79				0.63									

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[*] The four cost-levels for reading are defined in terms of the mean and standard deviation (s.d.) of the total resource cost of reading services for all CE students within each grade as follows: Low = one or more s.d. below the mean; Low-Average = zero to one s.d. below the mean; High-Average = zero to one s.d. above the mean; and High = one or more s.d. above the mean. The lower end point of each level is excluded from that level.

[**] F ratio is significant at the .01 level

[†] Test is not unique because of the empty cell.

Table D-15

Mean Reading Achievement Growth in Terms of Residual Gain Scores Based on the Estimated Regression Using Data From Non-CE Students Attending Non-CE Schools, for Subgroups of CE Students Classified by Their Characteristics and by Four Levels of Standard-Resource-Dollar Cost in Reading

GRADE	Cost Level (B)*	Student Characteristics (A_i)										Total
		Race/Ethnicity (A_1)		Free-Meals Program (A_2)		Need for CE (A_3)		Achievement Quartile (A_4)				
		White	Minority	Participant	Non-Participant	Need	No Need	Lowest	Second	Third	Highest	
1	Low	-10.96	9.59	5.24	-9.07	3.72	-4.33	-1.40	1.96	3.96	-3.86	-0.10
	Low-Average	-8.04	13.25	7.71	-3.91	8.65	-8.15	2.86	3.01	6.35	-4.18	2.66
	High-Average	-2.45	15.73	13.56	-3.99	10.32	-2.11	10.63	6.56	2.64	-3.43	6.70
	High	-2.98	9.57	6.03	-6.26	2.86	-11.39	2.40	-1.08	-5.92	13.29	0.48
	Total	-5.93	13.11	8.78	-4.91	7.56	-6.21	4.60	3.01	3.41	-2.94	3.06
	F-Tests for:											
	$B\|A_i,A_i \times B$	3.63		2.98		3.18		0.75				
	$A_i \times B\|A_i,B$	1.33		1.00		1.38		1.56				
2	Low	-2.48	-0.55	-1.60	-1.35	-4.13	1.48	-2.43	-2.11	1.34	-1.27	-1.51
	Low-Average	1.51	2.79	-1.33	5.79	1.97	2.16	-0.67	2.85	9.94	1.48	2.03
	High-Average	0.37	-0.95	-3.32	3.37	-0.49	1.11	-1.04	-2.41	9.64	-0.23	-0.21
	High	-3.66	-6.30	-9.53	-0.24	-4.02	-10.08	-6.84	-3.86	10.65	0.36	-4.56
	Total	-0.04	0.13	-2.91	3.46	-0.37	1.20	-1.90	-0.31	8.41	0.24	0.03
	F-Tests for:											
	$B\|A_i,A_i \times B$	4.41**		4.74**		3.18		1.40				
	$A_i \times B\|A_i,B$	0.52		1.19		1.07		0.56				
3	Low	-6.33	-1.58	-4.32	-4.28	-0.34	-8.75	-7.26	0.12	-5.60	-3.09	-4.30
	Low-Average	-6.75	2.32	-0.85	-5.08	-0.07	-8.95	-4.19	3.84	-5.39	-9.02	-2.51
	High-Average	0.19	1.03	-0.27	1.69	1.93	-8.90	-1.58	4.83	4.08	-12.91	0.57
	High	-7.84	0.99	-4.23	-4.20	-4.39	-1.43	-5.07	1.15	-12.37	-36.35	-4.22
	Total	-5.01	1.28	-1.61	-2.95	-0.29	-8.59	-3.93	3.18	-3.98	-8.96	-2.18
	F-Tests for:											
	$B\|A_i,A_i \times B$	2.61		3.61		0.16		1.38				
	$A_i \times B\|A_i,B$	3.13		1.70		1.26		0.96				
4	Low	2.73	-6.70	-4.92	3.95	1.92	-4.00	0.17	-2.03	1.60	-3.96	-0.59
	Low-Average	-0.80	-5.83	-3.63	-2.30	-0.27	-9.74	-4.01	-2.75	0.89	-2.97	-3.05
	High-Average	0.18	-0.07	0.18	-0.07	0.49	-2.98	0.47	-1.98	-1.55	20.32	0.07
	High	-3.63	4.60	0.85	-0.64	0.82	-4.91	3.73	-8.36	0.30	-4.67	0.30
	Total	-0.30	-2.42	-1.90	-0.33	0.44	-6.77	-0.63	-3.36	0.49	-0.95	-1.22
	F-Tests for:											
	$B\|A_i,A_i \times B$	1.54		1.16		1.35		1.11				
	$A_i \times B\|A_i,B$	4.24**		1.55		0.55		1.24				
5	Low	10.83	-2.58	0.62	11.94	10.81	-0.46	11.80	4.05	-2.51	7.96	6.83
	Low-Average	9.87	10.87	9.80	11.28	14.68	-6.93	12.42	8.48	3.27	11.02	10.37
	High-Average	15.46	14.18	13.98	16.13	16.67	-1.41	15.84	14.06	10.33	-3.19	14.79
	High	14.75	10.52	6.95	24.00	14.47	-12.02	15.02	5.01	-2.90	24.71	12.44
	Total	12.20	10.81	9.71	14.32	14.89	-4.61	13.93	9.05	3.00	8.45	11.52
	F-Tests for:											
	$B\|A_i,A_i \times B$	4.91**		4.64**		0.87		0.45				
	$A_i \times B\|A_i,B$	2.35		3.97**		1.48		0.55				
6	Low	-2.46	-11.28	-4.49	-3.81	-8.68	1.31	-3.91	-14.77	1.55	11.49	-4.06
	Low-Average	-3.17	-8.74	-6.41	-5.79	-7.18	-3.54	-6.61	-8.08	-1.05	-0.11	-6.16
	High-Average	-5.91	-1.61	-1.37	-7.00	-5.16	6.02	-1.83	-8.97	4.47	-8.32	-3.44
	High	-4.01	2.29	2.48	-6.97	-0.73	0.85	1.69	-5.97	-4.34	—	-0.61
	Total	-3.78	-4.79	-3.22	-5.82	-5.53	-0.32	-3.38	-8.96	0.29	4.62	-4.29
	F-Tests for:											
	$B\|A_i,A_i \times B$	1.91		0.93		2.21		0.40†				
	$A_i \times B\|A_i,B$	4.06**		1.94		1.20		0.95				

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* The four cost levels for reading are defined in terms of the mean and standard deviation (s.d.) of the total resource cost of reading services for all CE students within each grade as follows: Low = one or more s.d. below the mean; Low-Average = zero to one s.d. below the mean; High-Average = zero to one s.d. above the mean; and High = one or more s.d. above the mean. The lower end point of each level is excluded from that level.

** F-ratio is significant at the .01 level.

† Test is not unique because of the empty cell.

Note. — Sample sizes are provided in Table D-14

Table D-16

Mean Reading Achievement Growth in Terms of Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending CE Schools, for Subgroups of CE Students Classified by Their Characteristics and by Four Levels of Standard-Resource-Dollar Cost in Reading

GRADE	Cost Level (B)*	Student Characteristics (A_i)										Total
		Race/Ethnicity (A_1)		Free-Meals Program (A_2)		Need for CE (A_3)		Achievement Quartile (A_4)				
		White	Minority	Participant	Non-Participant	Need	No Need	Lowest	Second	Third	Highest	
1	Low	-9.29	4.50	0.84	-6.77	1.42	-5.78	-4.47	0.65	3.42	-5.01	-2.00
	Low-Average	-8.06	7.52	2.56	-3.86	5.25	-10.12	-1.18	0.80	4.75	-6.96	-0.23
	High-Average	-2.01	12.34	10.54	-3.11	8.27	-2.24	8.34	5.72	1.50	-3.70	5.21
	High	-0.99	2.91	2.58	-2.95	2.62	-17.55	3.01	-1.03	-9.35	7.87	0.08
	Total	-5.23	8.07	4.58	-3.86	5.23	-7.58	1.97	1.60	1.77	-4.79	1.05
	F-Tests for:											
	$B \mid A_i, A_i \times B$	4.56**		3.07		3.87**		1.31				
	$A_i \times B \mid A_i, B$	2.17		1.63		1.39		1.83				
2	Low	-2.56	-4.50	-4.26	-2.14	-3.56	-3.50	-3.74	-4.87	-2.50	-2.04	-3.53
	Low-Average	2.41	-0.39	-2.99	6.08	3.07	-3.08	-0.65	1.52	7.72	1.01	1.28
	High-Average	1.61	-3.78	-4.94	4.07	0.04	-4.43	-1.58	-3.07	8.59	1.78	-0.75
	High	-1.34	-8.20	-9.69	1.56	-2.37	-17.03	-4.88	-4.15	9.46	0.54	-3.67
	Total	1.07	-2.92	-4.54	4.01	0.60	-4.12	-1.90	-1.41	6.30	0.15	-0.59
	F-Tests for:											
	$B \mid A_i, A_i \times B$	3.45		3.59		3.50		2.06				
	$A_i \times B \mid A_i, B$	0.55		1.20		1.58		0.50				
3	Low	-4.80	-1.67	-2.84	-4.23	1.84	-9.41	-2.76	0.41	-10.06	-9.84	-3.46
	Low-Average	-4.81	3.72	1.97	-5.15	2.68	-10.06	1.04	2.69	-9.72	-14.75	-0.82
	High-Average	2.23	3.13	2.88	2.32	4.11	-7.58	3.25	4.22	-0.93	-19.19	2.64
	High	-4.06	2.58	-0.09	-2.69	-1.44	0.28	0.15	-0.08	-16.61	-43.69	-1.34
	Total	-2.80	2.71	1.31	-2.53	2.27	-9.11	1.11	2.39	-8.49	-14.96	-0.32
	F-Tests for:											
	$B \mid A_i, A_i \times B$	3.38		4.19**		0.60		1.37				
	$A_i \times B \mid A_i, B$	2.56		2.02		1.57		0.89				
4	Low	1.03	-1.54	-3.87	4.31	2.95	-3.70	-1.06	4.07	3.37	-6.80	0.12
	Low-Average	-0.98	1.46	1.61	-1.83	2.80	-6.34	-3.34	4.82	5.95	-0.33	0.12
	High-Average	-0.20	4.11	2.66	0.40	2.06	-1.06	-0.26	4.91	5.44	20.27	1.69
	High	-3.68	10.06	3.66	1.56	3.07	1.06	3.46	-0.83	10.08	8.30	2.89
	Total	-0.79	3.37	1.51	0.36	2.62	-4.32	-0.84	3.82	5.75	-0.57	1.02
	F-Tests for:											
	$B \mid A_i, A_i \times B$	0.83		0.57		0.55		1.38				
	$A_i \times B \mid A_i, B$	3.18		2.28		0.66		1.14				
5	Low	1.12	-6.42	-6.54	3.32	-1.58	-0.30	-0.03	-4.31	-4.50	8.44	-1.13
	Low-Average	-2.92	2.96	1.30	-2.02	0.67	-2.58	-1.19	0.64	1.84	8.68	0.02
	High-Average	-2.65	2.82	2.38	-3.35	0.30	-0.39	-1.55	3.56	6.66	-5.03	0.23
	High	-4.09	-2.03	-5.85	3.09	-2.58	-7.70	-2.32	-5.40	-2.38	0.62	-2.97
	Total	-2.30	1.36	-0.32	-0.81	-0.22	-1.94	-1.41	0.08	1.04	6.91	-0.51
	F-Tests for:											
	$B \mid A_i, A_i \times B$	0.98		0.13		0.49		0.31				
	$A_i \times B \mid A_i, B$	2.52		5.38**		0.34		0.71				
6	Low	-0.30	-1.93	-3.92	1.36	1.65	-3.22	5.64	-12.35	-1.39	7.96	-0.60
	Low-Average	0.89	1.94	0.34	3.15	4.11	-5.42	4.18	-2.63	-1.35	-1.99	1.45
	High-Average	3.24	9.44	6.12	7.98	6.81	6.79	9.68	-1.75	10.07	1.06	6.80
	High	4.08	16.05	11.00	9.60	11.01	5.26	13.38	3.99	4.69	—	10.55
	Total	1.61	6.43	3.52	4.75	5.95	-2.10	7.68	-2.80	0.17	2.69	4.03
	F-Tests for:											
	$B \mid A_i, A_i \times B$	6.21**		6.87**		4.35**		2.23†				
	$A_i \times B \mid A_i, B$	2.21		0.40		1.26		0.85				

*The four cost levels for reading are defined in terms of the mean and standard deviation (s.d.) of the total resource cost of reading services for all CE students within each grade as follows: Low = one or more s.d. below the mean; Low-Average = zero to one s.d. below the mean; High-Average = zero to one s.d. above the mean; and High = one or more s.d. above the mean. The lower end point of each level is excluded from that level.

**F-ratio is significant at the .01 level.

†Test is not unique because of the empty cell.

Note. — Sample sizes are provided in Table D-14.

Table D-17

Mean Reading Achievement Growth in Terms of VSS Scores, for Subgroups of CE Students Classified by Their Characteristics and by Four Levels of Standard-Resource-Dollar Cost in Reading

GRADE	Cost Level (B)[*]	Student Characteristics (A_i)										Total
		Race/Ethnicity (A_1)		Free-Meals Program (A_2)		Need for CE (A_3)		Achievement Quartile (A_4)				
		White	Minority	Participant	Non-Participant	Need	No Need	Lowest	Second	Third	Highest	
1	Low	54.45	63.43	59.31	58.99	53.40	65.59	59.92	60.66	66.13	49.44	59.19
	Low-Average	53.50	63.84	58.67	58.71	57.38	61.05	62.48	57.25	59.60	48.89	58.69
	High-Average	56.65	68.00	65.57	57.36	60.21	67.58	70.03	60.77	51.22	48.57	62.36
	High	54.10	59.86	56.94	54.17	54.65	60.85	63.46	51.61	43.52	42.73	55.69
	Total	54.53	64.63	60.47	57.67	57.28	63.48	64.60	57.56	55.97	48.56	59.30
	F-Tests for:											
	$B\|A_i, A_i \times B$	2.11		2.14		2.56		2.26				
	$A_i \times B\|A_i, B$	0.45		1.89		1.22		2.24				
2	Low	43.72	40.00	42.26	41.05	41.54	42.20	51.18	36.18	37.72	31.07	41.85
	Low-Average	48.01	43.56	42.57	50.31	46.36	45.86	51.34	41.63	44.80	33.52	46.22
	High-Average	46.12	41.19	41.26	47.08	43.53	46.01	52.02	35.26	38.52	28.03	43.96
	High	44.51	35.92	37.66	45.01	42.37	33.65	47.78	33.57	38.22	33.20	41.60
	Total	46.47	41.45	41.56	47.66	44.35	44.45	50.99	37.87	41.42	31.70	44.38
	F-Tests for:											
	$B\|A_i, A_i \times B$	2.77		2.97		2.74		1.70				
	$A_i \times B\|A_i, B$	0.36		1.41		0.84		0.64				
3	Low	32.51	30.21	30.42	32.91	34.06	28.68	35.30	34.01	22.47	17.95	31.53
	Low-Average	31.85	34.44	34.06	31.51	35.10	27.68	38.64	32.53	19.12	13.36	33.06
	High-Average	37.70	35.72	35.90	38.00	37.32	33.19	41.66	33.86	22.36	6.94	36.80
	High	33.21	35.93	34.96	33.64	33.74	43.96	39.85	29.36	4.48	-33.50	34.33
	Total	33.73	34.46	34.21	33.86	35.43	29.42	39.37	32.71	19.09	12.54	34.06
	F-Tests for:											
	$B\|A_i, A_i \times B$	2.74		3.09		2.42		2.71				
	$A_i \times B\|A_i, B$	1.12		1.02		2.08		1.81				
4	Low	33.12	27.74	29.38	33.15	32.43	29.58	37.56	25.89	27.64	18.58	31.22
	Low-Average	29.51	27.53	28.88	28.29	29.21	27.20	32.44	23.48	26.46	19.69	28.62
	High-Average	30.63	33.93	33.09	30.74	31.72	34.69	36.05	22.45	23.23	43.70	32.07
	High	26.58	39.26	34.19	29.98	32.12	37.90	40.28	16.36	22.69	19.50	32.64
	Total	30.04	31.50	31.12	30.09	30.97	29.68	35.67	22.38	25.63	21.77	30.67
	F-Tests for:											
	$B\|A_i, A_i \times B$	1.74		1.26		1.91		0.84				
	$A_i \times B\|A_i, B$	4.18[**]		0.73		0.66		1.43				
5	Low	28.78	16.62	17.42	31.51	23.61	28.00	29.99	19.23	17.21	33.42	25.16
	Low-Average	25.44	26.70	25.53	26.94	26.32	25.08	29.10	21.37	20.50	29.31	26.07
	High-Average	28.29	26.65	27.07	28.03	27.42	27.48	29.71	23.64	22.51	10.25	27.43
	High	27.39	24.28	21.28	34.99	26.06	21.30	29.09	14.86	16.50	20.00	25.70
	Total	27.06	25.50	24.51	29.05	26.35	26.01	29.38	20.95	19.90	28.53	26.30
	F-Tests for:											
	$B\|A_i, A_i \times B$	1.00		0.66		0.27		0.36				
	$A_i \times B\|A_i, B$	2.19		4.21[**]		0.50		0.63				
6	Low	24.90	18.02	20.77	25.34	22.78	24.65	29.57	13.93	23.90	27.30	23.65
	Low-Average	25.74	21.43	22.30	25.13	23.62	22.93	26.51	18.21	22.23	18.75	23.42
	High-Average	26.93	28.65	27.62	28.44	26.58	35.28	31.41	18.06	30.05	13.80	27.92
	High	27.99	34.29	32.88	28.33	31.21	33.42	34.93	23.29	22.80	—	31.39
	Total	26.14	25.66	25.56	26.39	25.83	26.13	29.83	18.34	23.68	22.30	25.90
	F-Tests for:											
	$B\|A_i, A_i \times B$	4.69[**]		3.70		4.45[**]		0.71[†]				
	$A_i \times B\|A_i, B$	2.29		0.90		1.19		0.52				

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[*] The four cost levels for reading are defined in terms of the mean and standard deviation (s.d.) of the total resource cost of reading services for all CE students within each grade as follows: Low = one or more s.d. below the mean; Low-Average = zero to one s.d. below the mean; High-Average = zero to one s.d. above the mean; and High = one or more s.d. above the mean. The lower end point of each level is excluded from that level.

[**] F-ratio is significant at the .01 level.

[†] Test is not unique because of the empty cell.

Note. — Sample sizes are provided in Table D-14.

Table D-18

Mean Math Achievement Growth in Terms of Standardized (z) Scores, for Subgroups of CE Students Classified by Their Characteristics and by Four Levels of Standard-Resource-Dollar Cost in Math

GRADE	Cost Level (B)*	Student Characteristics (A_i)																			
		Race/Ethnicity (A_1)				Free-Meals Program (A_2)				Need for CE (A_3)				Pretest Achievement Quartile (A_4)							
		White		Minority		Participant		Non-Partic.		Need		No Need		Lowest		Second		Third		Highest		Total
		N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
1	Low	103	-0.21	58	-0.17	77	-0.18	84	-0.21	55	-0.10	106	-0.25	44	0.34	38	-0.19	46	-0.34	33	-0.71	161	-0.19
	Low-Average	275	-0.15	394	0.16	432	0.08	237	-0.06	347	0.14	322	-0.08	272	0.39	193	-0.02	110	-0.12	94	-0.71	669	0.03
	High-Average	168	-0.08	251	0.17	265	0.08	154	0.05	283	0.06	136	0.09	174	0.46	126	-0.01	74	-0.21	45	-0.77	419	0.07
	High	46	0.06	113	0.16	124	0.14	35	0.10	124	0.15	35	0.08	97	0.33	39	-0.26	15	0.01	8	-0.11	159	0.13
	Total	592	-0.12	816	0.14	898	0.07	510	-0.04	809	0.09	599	-0.06	587	0.40	396	-0.06	245	-0.18	180	-0.70	1,408	0.03
	F-Tests for:																						
	$B \mid A_i, A_i \times B$	3.27				3.89**				3.08				1.33									
	$A_i \times B \mid A_i, B$	1.18				0.40				1.50				1.15									
2	Low	90	-0.06	58	-0.07	101	-0.09	47	-0.01	60	-0.09	88	-0.05	50	0.29	42	-0.09	29	-0.30	27	-0.43	148	-0.07
	Low-Average	398	0.01	366	0.00	469	-0.01	295	0.03	418	-0.00	346	0.02	309	0.29	223	0.01	123	-0.29	109	-0.46	764	0.01
	High-Average	167	0.10	250	-0.07	270	-0.02	147	0.04	285	-0.01	132	0.02	191	0.21	121	-0.03	48	-0.10	57	-0.55	417	-0.00
	High	81	-0.10	134	-0.01	148	-0.05	67	-0.03	170	-0.08	45	0.09	107	0.25	61	-0.23	30	-0.46	17	-0.43	215	-0.04
	Total	736	0.01	808	-0.03	988	-0.03	556	0.02	933	-0.02	611	0.02	657	0.26	447	-0.05	230	-0.27	210	-0.47	1,544	-0.01
	F-Tests for:																						
	$B \mid A_i, A_i \times B$	0.71				0.41				0.42				0.82									
	$A_i \times B \mid A_i, B$	1.53				0.08				0.38				0.92									
3	Low	86	0.11	80	0.03	102	0.03	64	0.13	76	0.08	90	0.06	80	0.19	46	0.09	26	0.08	14	-0.69	166	0.07
	Low-Average	356	-0.05	395	0.15	439	0.10	312	-0.01	435	0.07	316	0.03	319	0.26	220	-0.01	141	-0.14	71	-0.28	751	0.06
	High-Average	172	0.11	239	0.14	268	0.13	143	0.13	337	0.11	74	0.22	227	0.26	111	0.04	58	-0.15	15	-0.18	411	0.13
	High	97	0.07	130	-0.07	154	-0.05	73	0.08	202	0.01	25	-0.15	129	0.21	55	-0.18	30	-0.32	13	-0.63	227	-0.01
	Total	711	0.03	844	0.10	963	0.08	592	0.05	1,050	0.07	505	0.06	755	0.24	432	-0.01	255	-0.14	113	-0.36	1,555	0.07
	F-Tests for:																						
	$B \mid A_i, A_i \times B$	1.46				1.29				2.41				2.66									
	$A_i \times B \mid A_i, B$	4.15**				1.76				0.96				1.19									
4	Low	71	-0.02	39	-0.31	60	-0.23	50	0.02	43	-0.13	67	-0.12	34	-0.03	32	0.02	26	-0.06	18	-0.63	110	-0.12
	Low-Average	390	-0.02	332	-0.07	404	-0.08	318	0.00	469	0.01	253	-0.14	329	0.15	212	-0.09	110	-0.27	71	-0.47	722	-0.04
	High-Average	164	0.02	182	-0.05	196	0.02	150	-0.07	244	0.10	102	-0.30	174	0.22	96	-0.05	55	-0.49	21	-0.59	346	-0.01
	High	74	0.09	107	0.33	130	0.19	51	0.34	161	0.23	20	0.30	118	0.33	43	0.14	13	-0.17	7	-0.09	181	0.23
	Total	699	0.00	660	-0.01	790	-0.02	569	0.02	917	0.06	442	-0.15	655	0.19	383	-0.04	204	-0.29	117	-0.49	1,359	-0.01
	F-Tests for:																						
	$B \mid A_i, A_i \times B$	8.85**				9.55**				6.24**				3.07									
	$A_i \times B \mid A_i, B$	3.83**				2.44				4.32**				1.82									
5	Low	95	-0.07	28	-0.02	55	-0.03	68	-0.08	65	-0.06	58	-0.06	44	0.05	26	-0.07	42	-0.13	11	-0.20	123	-0.06
	Low-Average	319	0.06	337	0.07	412	0.05	244	0.09	484	0.09	172	0.01	365	0.23	165	-0.02	83	-0.21	43	-0.45	656	0.07
	High-Average	140	0.11	218	0.02	239	0.05	119	0.06	278	0.09	80	-0.05	200	0.20	83	-0.09	53	-0.08	22	-0.35	358	0.06
	High	51	0.16	124	0.09	142	0.10	33	0.15	154	0.14	21	-0.12	125	0.18	36	0.01	12	-0.23	2	-0.65	175	0.11
	Total	605	0.06	707	0.06	848	0.06	464	0.06	981	0.09	331	-0.03	734	0.20	310	-0.04	190	-0.15	78	-0.39	1,312	0.06
	F-Tests for:																						
	$B \mid A_i, A_i \times B$	1.35				1.92				1.04				0.26									
	$A_i \times B \mid A_i, B$	0.71				0.20				0.81				0.93									
6	Low	96	-0.10	22	0.09	56	-0.05	62	-0.08	54	-0.20	64	0.06	50	0.13	39	-0.14	20	-0.23	9	-0.40	118	-0.06
	Low-Average	416	0.04	383	0.04	456	0.06	343	0.01	474	0.07	325	0.00	423	0.16	193	0.03	130	-0.17	53	-0.38	799	0.04
	High-Average	154	-0.02	161	-0.01	189	0.02	126	-0.07	225	0.01	90	-0.07	168	0.16	90	-0.13	44	-0.36	13	-0.29	315	-0.01
	High	69	0.13	136	0.23	138	0.21	67	0.16	171	0.23	34	0.04	131	0.34	44	-0.04	24	-0.10	6	-0.13	205	0.20
	Total	735	0.02	702	0.07	839	0.07	598	0.00	924	0.07	513	-0.00	772	0.19	366	-0.03	218	-0.20	81	-0.35	1,437	0.04
	F-Tests for:																						
	$B \mid A_i, A_i \times B$	4.33**				5.78**				3.11				1.71									
	$A_i \times B \mid A_i, B$	0.66				0.09				3.06				1.04									

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* The four cost-levels for math are defined in terms of the mean and standard deviation (s.d.) of the total resource cost of math services for all CE students wtihin each grade as follows: Low = one or more s.d. below the mean; Low-Average = zero to one s.d. below the mean; High-Average = zero to one s.d. above the mean; and High = one or more s.d. above the mean. The lower end point of each level is excluded from that level.

** F-ratio is significant at the .01 level.

Table D-19

Mean-Math Achievement Growth in Terms of Residual Gain Scores Based on the Estimated Regression Using Data From Non-CE Students Attending Non-CE Schools, for Subgroups of CE Students Classified By Their Characteristics and by Four Levels of Standard-Resource-Dollar Cost in Math

GRADE	Cost Level (B)*	Student Characteristics (A_i): Race/Ethnicity (A_1)		Free-Meals Program (A_2)		Need for CE (A_3)		Achievement Quartile (A_4)				Total
		White	Minority	Participant	Non-Participant	Need	No Need	Lowest	Second	Third	Highest	
1	Low	-3.85	-1.37	-1.77	-4.05	6.17	-7.69	4.68	-7.42	-5.54	-4.40	-2.96
	Low-Average	-3.34	15.50	10.82	2.17	14.08	0.95	7.65	7.24	14.17	1.61	7.76
	High-Average	0.17	18.68	15.59	3.80	14.69	4.12	11.61	8.52	17.37	7.53	11.26
	High	-5.77	12.85	8.79	2.74	11.05	-5.26	3.72	-0.05	31.71	44.06	7.46
	Total	-2.62	14.91	10.87	1.68	13.29	-0.22	7.95	5.52	12.51	3.88	7.54
	F-Tests for:											
	$B\|A_i, A_i \times B$	4.27**		4.50**		3.21		8.22**				
	$A_i \times B\|A_i, B$	2.25		0.69		0.21		2.29				
2	Low	-4.43	2.99	-1.91	-0.69	-0.82	-2.00	3.85	-5.31	-7.35	0.69	-1.52
	Low-Average	1.12	2.04	0.04	3.98	2.06	0.96	1.22	3.59	-1.12	1.41	1.56
	High-Average	2.62	1.38	1.67	2.25	1.41	2.87	-0.53	3.45	9.08	0.51	1.87
	High	-7.35	3.93	0.42	-1.95	-2.53	8.02	3.37	-5.72	-6.45	6.62	-0.32
	Total	-0.15	2.22	0.34	2.42	0.84	1.47	1.26	1.45	-0.47	1.50	1.09
	F-Tests for:											
	$B\|A_i, A_i \times B$	0.61		0.52		0.38		0.72				
	$A_i \times B\|A_i, B$	1.58		0.42		1.01		1.08				
3	Low	-2.79	6.44	3.02	-0.52	12.74	-7.70	5.32	2.72	9.73	-37.79	1.66
	Low-Average	-3.92	17.93	12.83	0.18	16.02	-4.06	9.35	10.61	3.75	-2.26	7.57
	High-Average	5.31	18.92	14.86	10.16	15.83	1.35	13.72	13.20	12.54	8.51	13.22
	High	7.20	10.69	8.86	9.91	10.79	-3.70	12.79	6.90	5.11	-7.30	9.20
	Total	-0.03	16.00	11.72	3.71	14.72	-3.90	10.83	9.96	6.52	-5.81	8.67
	F-Tests for:											
	$B\|A_i, A_i \times B$	2.87		3.32		0.84		3.81**				
	$A_i \times B\|A_i, B$	3.59		1.94		0.40		1.14				
4	Low	-4.27	-9.10	-10.22	-0.89	-10.47	-3.10	-16.38	1.79	9.65	-22.73	-5.98
	Low-Average	-4.08	-4.45	-7.02	-0.74	-0.43	-11.33	-5.39	-1.95	-0.67	-11.41	-4.25
	High-Average	-2.46	-2.92	-0.52	-5.55	5.60	-22.57	0.75	1.64	-15.12	-18.65	-2.70
	High	0.32	17.67	7.37	18.76	10.65	9.93	8.37	17.67	6.11	12.40	10.58
	Total	-3.25	-0.72	-3.28	-0.27	2.65	-11.71	-1.85	1.46	-2.82	-13.02	-2.02
	F-Tests for:											
	$B\|A_i, A_i \times B$	4.83**		6.69**		3.76		3.30				
	$A_i \times B\|A_i, B$	2.31		1.90		5.64**		1.65				
5	Low	-5.96	13.69	5.42	-6.98	-0.35	-2.66	-8.90	1.71	1.98	7.93	-1.44
	Low-Average	0.41	8.83	6.56	1.67	6.83	-1.16	5.48	8.61	-1.27	-4.83	4.74
	High-Average	4.28	5.06	5.68	2.89	8.28	-7.49	3.87	5.04	9.16	1.05	4.75
	High	0.46	4.91	3.53	3.95	6.85	-20.15	1.35	12.03	1.54	5.87	3.61
	Total	0.31	7.18	5.73	0.87	6.77	-4.16	3.47	7.47	2.54	-1.10	4.01
	F-Tests for:											
	$B\|A_i, A_i \times B$	0.09		0.47		1.23		0.28				
	$A_i \times B\|A_i, B$	1.31		0.50		1.72		0.74				
6	Low	-10.17	13.33	0.68	-11.63	-11.28	-1.16	2.37	-11.31	-12.61	-12.05	-5.79
	Low-Average	-1.13	12.20	11.90	-3.49	10.14	-1.77	5.83	7.33	4.26	-3.83	5.30
	High-Average	-6.09	5.75	5.99	-9.09	3.71	-9.41	4.77	-3.37	-9.94	-5.76	-0.04
	High	6.00	20.34	18.42	9.55	17.78	4.14	20.33	6.03	8.92	6.43	15.52
	Total	-2.68	12.38	10.89	-4.05	8.73	-2.64	7.84	2.56	0.36	-4.29	4.67
	F-Tests for:											
	$B\|A_i, A_i \times B$	3.52		6.06**		4.27**		2.88				
	$A_i \times B\|A_i, B$	0.33		0.28		2.17		0.74				

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[*] The four cost-levels for math are defined in terms of the mean and standard deviation (s.d.) of the total resource cost of math services for all CE students within each grade as follows: Low = one or more s.d. below the mean; Low-Average = zero to one s.d. below the mean; High-Average = zero to one s.d. above the mean; and High = one or more s.d. above the mean. The lower end point of each level is excluded from that level.

[**] F-ratio is significant at the .01 level.

Note. — Sample sizes are provided in Table D-18.

Table D-20

Mean Math Achievement Growth in Terms of Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending CE Schools, for Subgroups of CE Students Classified by Their Characteristics and by Four Levels of Standard-Resource-Dollar Cost in Math

GRADE	Cost Level (B)*	Student Characteristics (A_i): Race/Ethnicity (A_1)		Free-Meals Program (A_2)		Need for CE (A_3)		Achievement Quartile (A_4)				Total
		White	Minority	Participant	Non-Participant	Need	No Need	Lowest	Second	Third	Highest	
	Low	-6.25	-8.47	-7.40	-6.74	0.64	-11.05	-1.65	-9.32	-6.46	-12.47	-7.05
	Low-Average	-5.72	6.55	3.28	-1.72	7.01	-4.43	0.33	3.39	9.40	-8.20	1.51
1	High-Average	-1.22	10.27	8.04	1.58	8.61	-0.47	6.21	5.13	11.19	-4.05	5.66
	High	-8.51	4.20	0.86	-0.67	4.04	-11.94	-3.48	-4.24	24.28	27.75	0.53
	Total	-4.75	6.30	3.43	-1.48	6.68	-5.14	1.30	1.97	7.87	-6.34	1.65
	F-Tests for:											
	$B \mid A_i, A_i \times B$	4.37**		4.18**		3.08		5.85**				
	$A_i \times B \mid A_i, B$	1.78		0.44		0.28		1.88				
	Low	-7.31	-5.20	-7.10	-5.17	-3.96	-8.21	-7.21	-9.55	-8.73	2.04	-6.49
	Low-Average	1.51	-6.37	-5.78	3.32	0.56	-5.69	-7.40	1.49	0.69	1.27	-2.27
2	High-Average	3.29	-5.79	-4.45	2.06	-2.23	-1.98	-12.36	0.42	12.03	14.64	-2.15
	High	-5.52	-4.67	-6.24	-2.23	-5.71	-2.30	-7.94	-6.78	-2.37	15.36	-4.99
	Total	0.06	-5.83	-5.62	1.60	-1.72	-5.00	-8.92	-0.96	1.47	6.14	-3.02
	F-Tests for:											
	$B \mid A_i, A_i \times B$	0.81		0.81		0.41		2.05				
	$A_i \times B \mid A_i, B$	1.34		0.44		0.93		1.68				
	Low	-6.80	-8.30	-9.10	-4.99	-4.96	-9.68	-7.73	-4.45	1.49	-33.16	-7.52
	Low-Average	-9.96	0.90	-2.75	-6.36	-2.80	-6.25	-4.23	-4.43	-4.65	-2.99	-4.25
3	High-Average	-3.56	-0.81	-3.46	0.85	-2.18	0.35	-2.41	-2.16	-0.68	1.46	-1.96
	High	-5.23	-10.85	-10.92	-3.24	-7.75	-14.06	-6.20	-11.70	-8.66	-16.53	-8.45
	Total	-7.38	-2.27	-4.93	-4.08	-3.71	-6.47	-4.39	-4.77	-3.59	-7.70	-4.61
	F-Tests for:											
	$B \mid A_i, A_i \times B$	1.43		1.36		1.55		2.44				
	$A_i \times B \mid A_i, B$	3.35		1.66		0.33		0.97				
	Low	-7.08	-11.68	-13.14	-3.40	-19.44	-1.83	-17.85	-5.39	7.14	-20.23	-8.71
	Low-Average	-8.39	-9.34	-10.94	-6.15	-9.46	-7.65	-6.34	-12.55	-9.38	-8.40	-8.83
4	High-Average	-6.75	-9.31	-5.89	-10.99	-3.66	-18.72	-1.22	-10.27	-23.84	-14.01	-8.10
	High	-4.55	11.05	2.71	9.68	3.50	14.11	6.76	1.99	-7.26	8.13	4.67
	Total	-7.47	-6.17	-7.61	-5.76	-6.11	-8.34	-3.22	-9.75	-11.04	-10.23	-6.84
	F-Tests for:											
	$B \mid A_i, A_i \times B$	3.85**		4.95**		4.23**		1.06				
	$A_i \times B \mid A_i, B$	2.09		1.40		4.78**		1.85				
	Low	-11.12	[illegible].25	0.17	-12.69	-4.01	-10.23	-9.60	-4.92	-6.89	-1.30	-6.94
	Low-Average	-1.63	6.14	4.20	-0.74	5.11	-5.36	5.20	3.82	-6.69	-9.83	2.36
5	High-Average	2.47	2.84	3.75	0.58	6.64	-11.02	3.23	1.12	6.15	-4.59	2.69
	High	0.88	3.19	1.83	5.49	5.88	-22.15	0.77	9.89	-0.90	-0.54	2.52
	Total	-1.96	4.65	3.42	-1.71	5.06	-8.65	3.02	3.07	-2.79	-6.91	1.60
	F-Tests for:											
	$B \mid A_i, A_i \times B$	0.27		1.39		1.39		0.65				
	$A_i \times B \mid A_i, B$	1.24		0.72		1.38		0.77				
	Low	-7.81	2.94	-2.68	-8.63	-14.35	1.40	0.35	-11.17	-10.31	-6.76	-5.81
	Low-Average	0.87	7.84	9.03	-2.19	8.00	-1.32	6.78	3.63	-0.16	-3.46	4.21
6	High-Average	-0.44	4.06	6.90	-5.71	4.85	-5.62	9.74	-5.74	-12.46	1.05	1.86
	High	8.73	21.84	19.92	12.29	19.60	6.49	24.35	3.57	6.68	10.84	17.43
	Total	0.20	9.53	9.56	-1.98	8.07	-1.22	9.99	-0.26	-2.82	-2.04	4.76
	F-Tests for:											
	$B \mid A_i, A_i \times B$	4.25**		6.54**		3.93**		2.14				
	$A_i \times B \mid A_i, B$	0.38		0.23		2.83		0.86				

[*] The four cost-levels for math are defined in terms of the mean and standard deviation (s.d.) of the total resource cost of math services for all CE students within each grade as follows: Low = one or more s.d. below the mean; Low-Average = zero to one s.d. below the mean; High-Average = zero to one s.d. above the mean; and High = one or more s.d. above the mean. The lower end point of each level is excluded from that level.

[**] F-ratio is significant at the .01 level.

Note. — Sample sizes are provided in Table D-18.

Table D-21

Mean Math Achievement Growth in Terms of VSS Scores, for Subgroups of CE Students Classified by Their Characteristics and by Four Levels of Standard-Resource-Dollar Cost in Math

GRADE	Cost Level (B)*	Student Characteristics (A_i)										Total
		Race/Ethnicity (A_1)		Free-Meals Program (A_2)		Need for CE (A_3)		Achievement Quartile (A_4)				
		White	Minority	Participant	Non-Participant	Need	No Need	Lowest	Second	Third	Highest	
1	Low	54.88	49.47	49.55	56.04	51.62	53.61	65.68	49.92	52.02	40.67	52.93
	Low-Average	53.48	65.27	61.25	58.92	61.07	59.72	67.90	58.16	61.11	42.64	60.42
	High-Average	55.81	64.76	60.70	61.99	59.00	65.71	70.99	58.24	56.64	38.91	61.17
	High	55.00	61.50	59.88	58.69	59.50	60.03	63.73	45.59	65.40	67.25	59.62
	Total	54.50	63.47	59.89	59.35	59.46	60.02	67.96	56.16	58.31	42.44	59.70
	F-Tests for:											
	$B \mid A_i, A_i \times B$	1.84		2.08		2.38		1.19				
	$A_i \times B \mid A_i, B$	2.19		0.65		0.92		1.16				
2	Low	51.29	49.53	48.68	54.72	46.30	53.53	61.62	48.26	42.10	42.96	50.60
	Low-Average	54.89	52.87	52.35	56.42	50.81	57.68	61.66	53.70	43.89	43.76	53.92
	High-Average	57.83	48.88	51.16	54.87	49.87	58.08	56.70	51.04	54.13	39.91	52.47
	High	46.80	52.62	49.96	51.46	47.19	62.67	60.62	41.23	35.77	45.18	50.43
	Total	54.23	51.36	51.29	55.27	49.57	57.54	60.05	50.77	44.74	42.73	52.72
	F-Tests for:											
	$B \mid A_i, A_i \times B$	0.79		0.52		0.53		0.69				
	$A_i \times B \mid A_i, B$	1.63		0.09		0.48		1.00				
3	Low	57.76	49.63	50.84	58.61	55.03	52.83	60.44	58.41	54.35	0.14	53.84
	Low-Average	54.05	54.11	52.52	56.28	52.97	55.62	62.42	52.35	46.21	37.63	54.08
	High-Average	59.60	53.83	53.38	61.62	54.37	64.77	61.72	52.77	46.38	37.27	56.25
	High	55.73	43.07	44.98	55.86	49.38	41.20	57.36	40.75	37.40	18.69	48.48
	Total	56.07	51.90	51.38	57.77	52.88	55.75	61.13	51.63	46.04	30.76	53.81
	F-Tests for:											
	$B \mid A_i, A_i \times B$	1.52		1.31		2.74		3.03				
	$A_i \times B \mid A_i, B$	1.64		0.53		1.43		1.56				
4	Low	48.65	33.72	36.30	51.82	38.00	46.79	41.38	52.88	54.85	13.56	43.35
	Low-Average	47.74	43.80	43.06	49.57	47.74	42.56	53.37	44.69	40.59	23.37	45.93
	High-Average	50.23	45.16	49.00	45.59	53.60	33.13	58.39	46.41	27.36	16.14	47.57
	High	52.62	69.07	59.52	69.57	61.53	68.90	66.32	59.56	44.46	45.71	62.35
	Total	48.93	47.68	46.75	50.51	51.27	42.21	56.42	47.48	39.09	21.90	48.32
	F-Tests for:											
	$B \mid A_i, A_i \times B$	6.27**		7.36**		5.09**		2.44				
	$A_i \times B \mid A_i, B$	3.46		1.76		4.04**		1.67				
5	Low	37.39	39.82	38.56	37.44	34.75	41.52	40.05	37.19	35.98	38.82	37.94
	Low-Average	44.98	42.88	41.98	47.15	43.94	43.78	52.21	40.01	26.54	21.86	43.90
	High-Average	50.07	37.19	40.56	45.56	43.55	37.63	49.58	35.24	31.87	26.73	42.23
	High	47.20	41.69	41.68	50.27	45.26	28.90	46.84	39.39	23.17	13.00	43.30
	Total	45.16	40.79	41.31	45.54	43.43	40.95	49.85	38.42	29.90	25.40	42.81
	F-Tests for:											
	$B \mid A_i, A_i \times B$	0.39		0.85		0.97		0.22				
	$A_i \times B \mid A_i, B$	1.32		0.25		1.26		0.74				
6	Low	32.54	43.73	35.36	33.97	22.74	44.66	46.14	26.44	26.35	24.56	34.63
	Low-Average	42.00	40.82	42.06	40.60	41.33	41.59	47.62	37.75	32.51	27.36	41.43
	High-Average	36.21	36.96	38.63	33.54	37.09	35.36	47.13	26.90	17.59	31.92	36.59
	High	48.71	54.69	53.51	50.96	53.95	46.29	62.59	32.43	37.29	46.33	52.68
	Total	40.18	42.71	42.73	39.58	41.54	41.19	49.96	33.24	29.46	23.19	41.42
	F-Tests for:											
	$B \mid A_i, A_i \times B$	4.29**		5.45**		3.34		1.70				
	$A_i \times B \mid A_i, B$	0.61		0.12		2.43		0.96				

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[*] The four cost-levels for math are defined in terms of the mean and standard deviation (s.d.) of the total resource cost of math services for all CE students within each grade as follows: Low = one or more s.d. below the mean; Low-Average = zero to one s.d. below the mean; High-Average = zero to one s.d. above the mean; and High = one or more s.d. above the mean. The lower end point of each level is excluded from that level.

[**] F-ratio is significant at the .01 level.

Note. — Sample sizes are provided in Table D-18.

Table D-22

Average Residual-Gains in Practical Achievement for CE Students by Four Levels of Standard-Resource-Dollar Cost in Reading and in Math

Math Cost Levels*	Grade 4					Grade 5					Grade 6				
	Reading Cost Levels*					Reading Cost Levels*					Reading Cost Levels*				
	Low	Low Average	High Average	High	Total	Low	Low Average	High Average	High	Total	Low	Low Average	High Average	High	Total
Mean Residual Gain Scores Based on the Estimated Regression Using Data from the Non-CE Students Attending Non-CE Schools (Sample sizes are provided in the first row for each math cost-level, and omitted in the lower section)															
Low	136	169	67	52	424	152	187	81	25	445	92	89	54	4	239
	-0.75	-0.81	-0.73	0.41	-0.63	-0.[illegible]7	0.00	0.69	-0.73	0.06	-0.28	1.05	0.84	4.47	0.55
Low Average	298	582	328	135	1,343	171	554	308	84	1,117	225	697	308	119	1,349
	-0.12	-0.55	-0.52	-0.61	-0.45	0.13	0.23	-0.21	0.67	0.13	0.70	1.05	1.08	0.56	0.95
High Average	42	153	182	63	440	38	207	157	100	502	45	190	132	73	440
	-0.91	-0.22	0.24	0.09	-0.05	0.97	-0.14	0.19	0.21	0.12	0.39	1.81	1.39	1.71	1.52
High	9	16	65	108	198	18	43	45	93	199	13	43	89	114	259
	-0.34	0.12	-0.04	1.52	0.81	-0.34	-1.43	-0.06	-1.63	-1.11	0.89	1.20	0.56	1.38	1.04
Total	485	920	642	358	2.405	379	991	591	302	2,263	375	1,019	583	310	2,287
	-0.37	-0.53	-0.28	0.31	-0.31	0.11	0.04	0.03	-0.30	0.01	0.43	1.20	1.05	1.18	1.03
Mean Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending CE Schools															
Low	-0.78	-0.76	-0.62	0.11	-0.64	-0.80	-1.08	-0.80	-2.11	-0.99	-0.59	0.20	-0.77	1.38	-0.31
Low Average	-0.07	-0.45	-0.65	-0.77	-0.44	-0.62	-0.53	-1.12	-0.51	-0.70	0.18	0.08	-0.02	-0.27	0.04
High Average	-0.55	-0.19	0.02	0.06	-0.10	-0.32	-0.63	-0.71	-0.54	-0.61	-0.12	0.93	0.12	0.53	0.51
High	-0.23	-0.08	-0.18	1.66	0.83	-1.66	-2.32	-0.52	-2.30	-1.84	0.55	0.28	-0.55	-0.19	-0.20
Total	-0.31	-0.45	-0.41	0.24	-0.31	-0.71	-0.73	-0.92	-1.20	-0.84	-0.04	0.26	-0.14	-0.03	0.07

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* The four cost-levels for reading and math are defined in terms of the mean and standard deviation (s.d.) of the total resource costs of reading/math services for all CE students within each grade as follows: Low = one or more s.d. below the mean; Low-Average = zero to one s.d. below the mean; High Average = zero to one s.d. above the mean; and High = one or more s.d. above the mean. The lower end point of each level is excluded from that level.

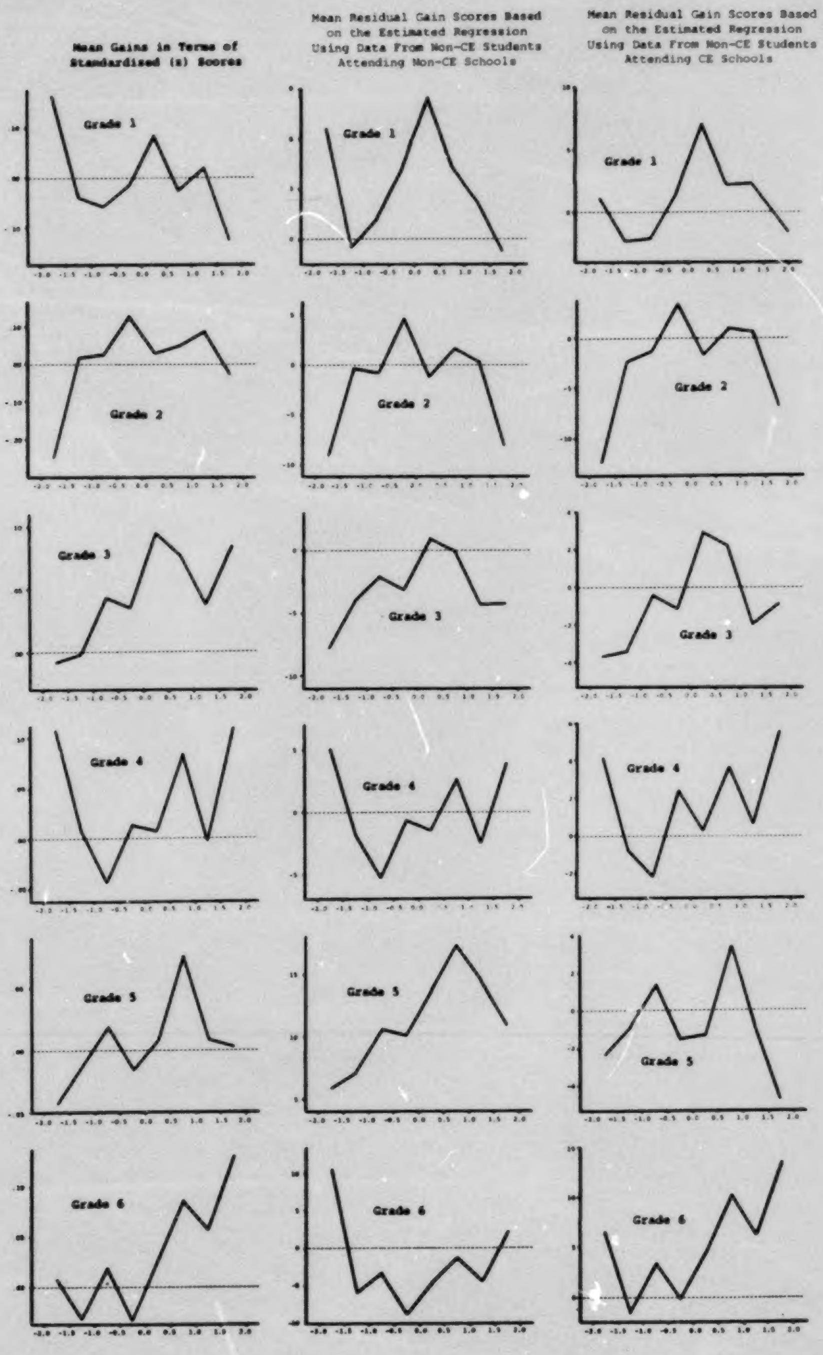
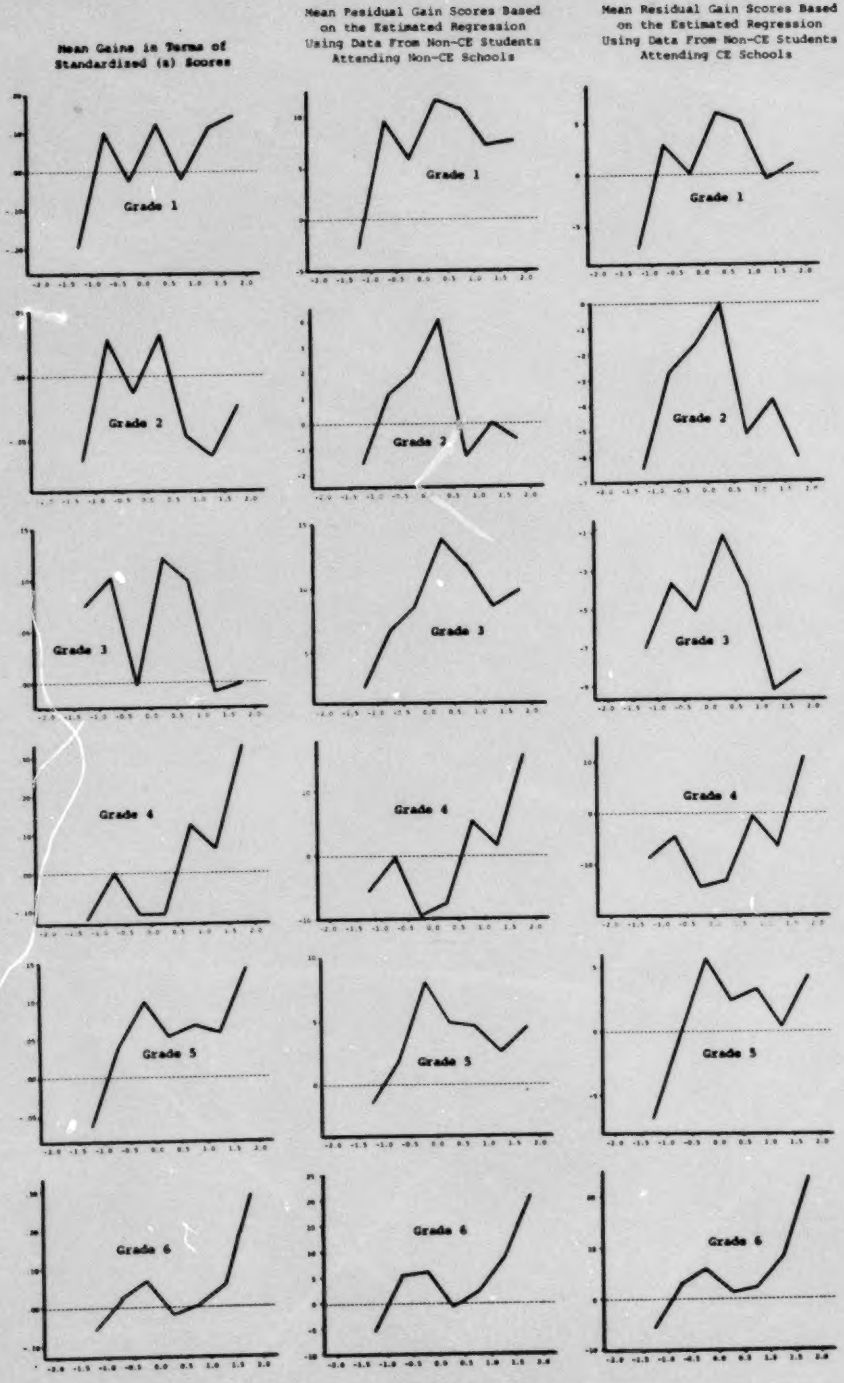


Figure D-1

Average Fall-to-Spring Gains (Vertical Axis) in Reading for CE Students by Levels of Reading Service Costs (Horizontal Axis, Indexed by Number of Standard Deviations Away From the Mean Costs)

Note. — Numbers of cases on which means are based can be found in Table D-4.



Mean Gains in Terms of Standardized (z) Scores

Mean Residual Gain Scores Based on the Estimated Regression Using Data From Non-CE Students Attending Non-CE Schools

Mean Residual Gain Scores Based on the Estimated Regression Using Data From Non-CE Students Attending CE Schools

Figure D-2

Average Fall-to-Spring Gains (Vertical Axis) in Math for CE Students by Levels of Math Service Costs (Horizontal Axis, Indexed by Number of Standard Deviations Away From the Mean Costs)

Note. — Numbers of cases on which means are based can be found in Table D-6.

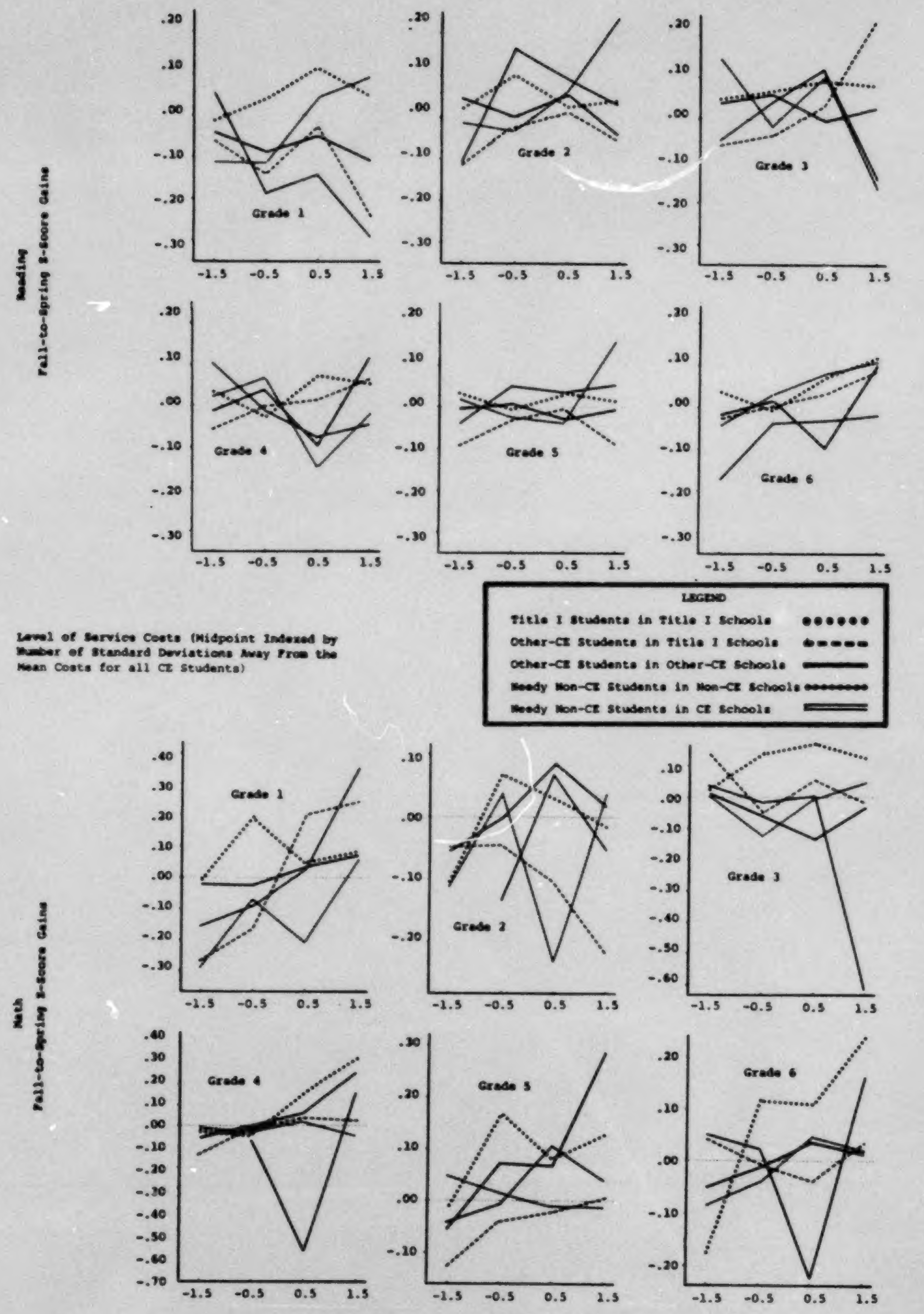


Figure D-3

Average Fall-to-Spring Z-Score Gains (Vertical Axis) for the Three Groups of CE Students and Two Groups of Needy Non-CE Students, by Levels of Service Costs (Horizontal Axis)

Note. — Numbers of cases on which means are based can be found in Tables D-8 and D-10. Means based on fewer than five cases are not plotted.

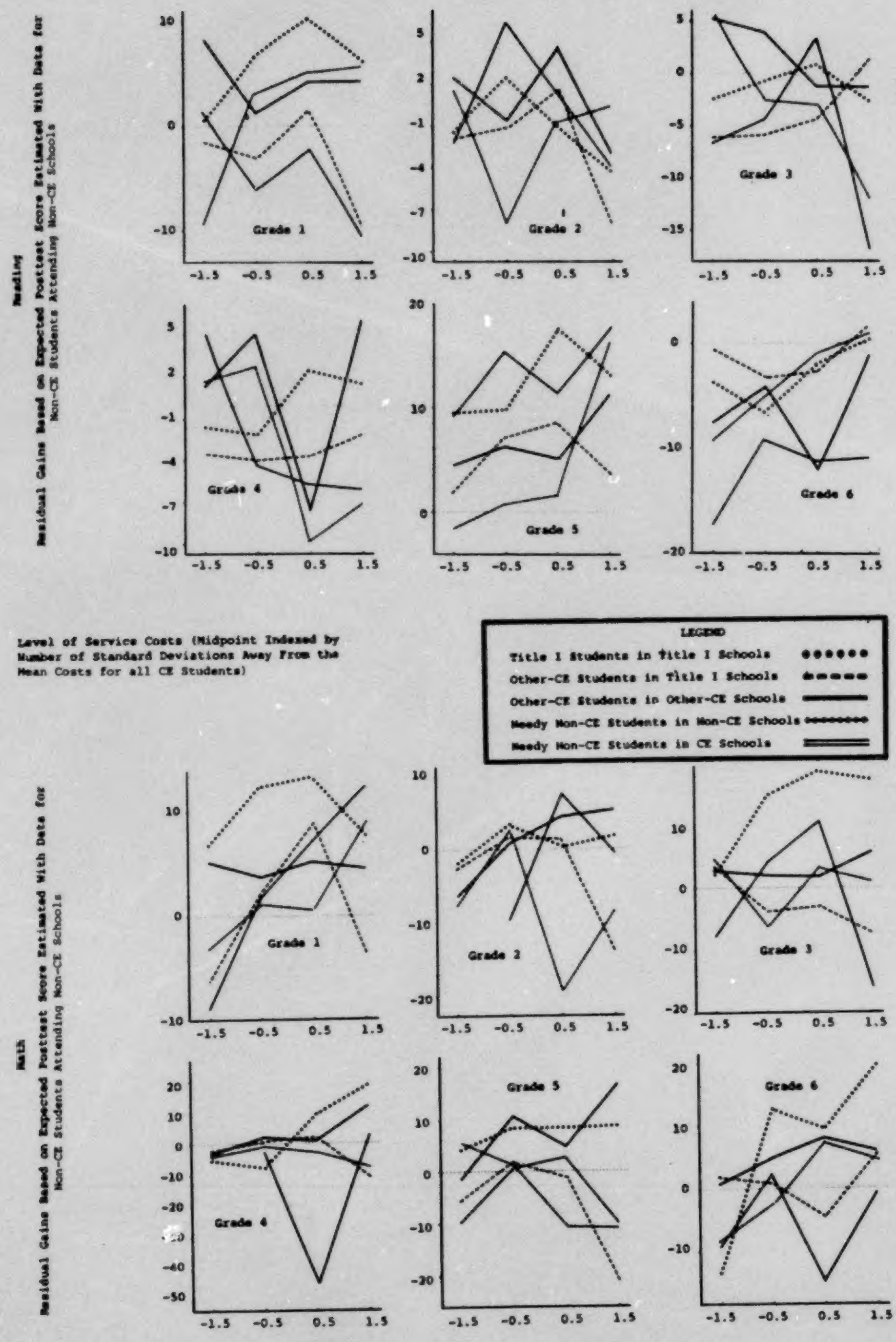


Figure D-4

Average Residual Gains Based on Expected Posttest Score Estimated With Data for Non-CE Students Attending Non-CE Schools (Vertical Axis) for the Three Groups of CE Students and Two Groups of Needy Non-CE Students, by Levels of Service Costs (Horizontal Axis).

Note. — Numbers of cases on which means are based can be found in Tables D-8 and D-10. Means based on fewer than five cases are not plotted.

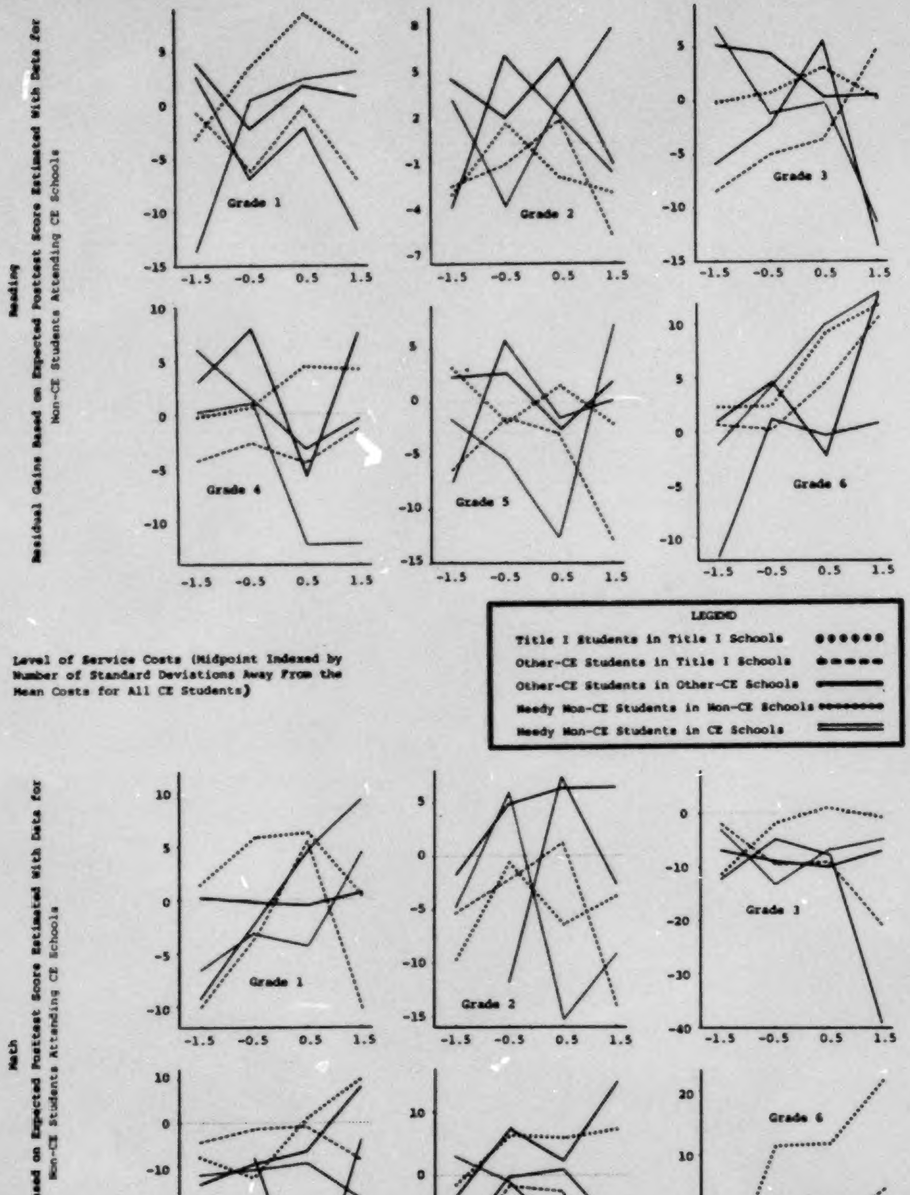


Figure D-5

Average Residual Gains Based on Expected Posttest Score Estimated With Data for Non-CE Students Attending CE Schools (Vertical Axis) for the Three Groups of CE Students and Two Groups of Needy Non-CE Students, by Levels of Service Costs (Horizontal Axis).

Note. — Numbers of Cases on which means are based can be found in Table D-8 and D-10. Means based on fewer than five cases are not plotted.

APPENDIX E

SUPPLEMENTARY TABLES FOR CHAPTER 5

Table E-1

Indicators of Fall-to-Spring Reading Achievement Growth for CE Students and Two Comparison Groups of Non-CE Students Judged to be in Need of Reading CE

GRADE	Reading CE Students and Comparison Groups*	Mean VSS Gain as a Percentage of that Required to Maintain the 50th Percentile Rank	Average Pretest Percentile Score	Average Posttest Percentile Score	Mean Posttest Score as a Percentage of the Expected Mean Estimated With	
	Selection/School				Model A**	Model B**
1	Title I/Title I	89.1	29.7	30.4	101.8	100.1
	Other-CE/Title I	89.6	40.7	39.7	99.4	99.0
	Other-CE/Other-CE	81.5	40.4	35.0	98.6	98.5
	Needy Non-CE/CE	82.5	29.5	27.6	100.9	99.9
	Needy Non-CE/Non-CE	79.4	28.8	25.2	100.1	99.3
2	Title I/Title I	91.8	25.6	26.4	99.9	99.7
	Other-CE/Title I	88.8	41.5	40.0	99.7	99.6
	Other-CE/Other-CE	98.8	29.9	32.2	100.6	100.7
	Needy Non-CE/CE	85.6	26.6	25.9	100.2	100.6
	Needy Non-CE/Non-CE	82.6	24.1	22.4	99.3	99.9
3	Title I/Title I	102.3	22.6	24.6	99.8	100.2
	Other-CE/Title I	88.6	37.1	37.0	98.9	99.1
	Other-CE/Other-CE	100.1	30.0	30.7	99.2	99.7
	Needy Non-CE/CE	98.8	25.8	27.3	100.6	100.8
	Needy Non-CE/Non-CE	85.4	23.1	22.4	99.7	100.1
4	Title I/Title I	106.3	21.5	22.7	100.0	100.5
	Other-CE/Title I	96.5	33.0	33.1	99.4	99.4
	Other-CE/Other-CE	99.5	29.0	29.4	99.3	100.2
	Needy Non-CE/CE	102.0	26.6	27.4	100.4	100.8
	Needy Non-CE/Non-CE	102.5	23.9	24.7	100.2	99.8
5	Title I/Title I	93.3	21.0	21.2	102.5	99.9
	Other-CE/Title I	88.5	35.1	34.4	101.3	99.4
	Other-CE/Other-CE	103.3	26.5	27.5	102.9	100.5
	Needy Non-CE/CE	91.6	25.9	26.0	101.1	100.4
	Needy Non-CE/Non-CE	83.7	20.4	20.2	100.1	99.3
6	Title I/Title I	100.0	20.1	21.1	99.4	101.3
	Other-CE/Title I	103.3	33.3	34.1	99.6	100.4
	Other-CE/Other-CE	80.8	23.0	22.1	97.9	99.8
	Needy Non-CE/CE	91.9	27.8	27.7	98.9	100.6
	Needy Non-CE/Non-CE	96.7	21.9	22.4	98.8	100.6

* Sample sizes for these groups are available in tables presented earlier and therefore are omitted here.

** Model A - Regression of posttest score on pretest and selected student background characteristics as estimated from data from non-CE students attending schools that do not provide CE in reading; Model B - Similar to Model A but the regression equation was estimated from data for non-CE students attending schools that provide CE in reading. Please refer to Appendix B5 for further descriptions of these models,

Table E-2

Indicators of Fall-to-Spring Math Achievement Growth for CE Students and Two Comparison Groups of Non-CE Students Judged to be in Need of Math CE

GRADE	Math CE Students and Comparison Groups* Selection/School	Mean VSS Gain as a Percentage of that Required to Maintain the 50th Percentile Rank	Average Pretest Percentile Score	Average Posttest Percentile Score	Mean Posttest Score as a Percentage of the Expected Mean Estimated With	
					Model A**	Model B**
1	Title I/Title I	97.7	30.8	33.8	103.2	101.3
	Other-CE/Title I	90.8	43.6	41.7	100.3	99.1
	Other-CE/Other-CE	99.1	42.0	44.2	101.2	100.3
	Needy Non-CE/CE	85.9	26.0	26.2	101.3	100.0
	Needy Non-CE/Non-CE	78.0	29.0	25.1	100.2	99.0
2	Title I/Title I	95.4	27.5	29.1	100.5	99.2
	Other-CE/Title I	96.4	42.8	42.4	100.0	99.4
	Other-CE/Other-CE	97.1	38.7	39.7	100.0	99.7
	Needy Non-CE/CE	90.1	26.5	26.6	100.3	101.1
	Needy Non-CE/Non-CE	83.5	25.6	24.5	99.4	100.2
3	Title I/Title I	96.3	26.1	30.1	103.4	99.7
	Other-CE/Title I	86.6	40.2	40.2	99.1	97.9
	Other-CE/Other-CE	80.6	37.4	34.3	100.3	98.0
	Needy Non-CE/CE	85.3	25.9	25.7	100.5	98.3
	Needy Non-CE/Non-CE	87.1	24.4	23.7	100.0	98.3
4	Title I/Title I	86.8	23.4	25.7	100.3	99.1
	Other-CE/Title I	73.6	37.5	35.9	99.6	99.2
	Other-CE/Other-CE	55.1	33.7	28.8	97.4	96.6
	Needy Non-CE/CE	78.4	25.5	25.6	100.3	98.3
	Needy Non-CE/Non-CE	76.4	24.5	25.0	99.8	97.9
5	Title I/Title I	113.9	23.2	25.8	101.4	100.9
	Other-CE/Title I	97.9	38.8	37.8	100.0	99.4
	Other-CE/Other-CE	109.6	28.6	29.5	99.9	99.7
	Needy Non-CE/CE	100.9	24.7	25.6	101.2	100.7
	Needy Non-CE/Non-CE	92.9	23.3	23.8	100.0	99.7
6	Title I/Title I	85.5	25.5	28.0	102.0	102.2
	Other-CE/Title I	76.1	36.8	36.3	100.1	99.9
	Other-CE/Other-CE	70.3	25.8	25.4	99.2	99.4
	Needy Non-CE/CE	68.8	26.7	26.2	100.8	99.9
	Needy Non-CE/Non-CE	65.5	24.6	24.0	99.9	99.0

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* Sample sizes for these groups are available in tables presented earlier and therefore are omitted here.

** Model A - Regression of posttest score on pretest and selected student background characteristics as estimated from data for non-CE students attending schools that do not provide CE in math; Model B - Similar to Model A but the regression equation was estimated from data for non-CE students attending schools that provide CE in math. Please refer to Appendix B5 for further descriptions of these models,

Table E-3

Projected Population Means of Hours of Instructional Services Received in the 1976-77 School Year for Special and Non-Special Instruction*

Grade	Projected Means for Reading		Projected Means for Math	
	Special Instruction	Non-Special Instruction	Special Instruction	Non-Special Instruction
1	59.44	242.38	16.34	149.89
2	59.70	228.10	21.19	147.95
3	46.97	185.26	18.67	146.63
4	35.77	163.04	22.11	145.10
5	31.49	158.62	24.16	142.88
6	30.28	147.85	18.07	144.14

* Special Instruction: instruction by special teachers, and assistants/aides, and instruction by classroom teachers in small groups (1-6);

Non-Special Instruction: instruction by classroom teachers in groups of 7 or more, instruction by tutor, and Independent seat work.

Table E-4

Average Pretest VSS in Reading for Reading CE Students by Participation History and Intensity of Reading Services Received

GRADE	Reading CE Status in 1975-1977 School Years (A)		Amount of Services Received from Special Teachers and in Small Groups/Amount of Services Received in Less Intensive Settings (B)					ANOVA Test Statistics	
			High/High	High/Low	Low/High	Low/Low	Total	Effect*	F
1	Received CE 76 and 75	N	126	341	31	84	582		
		Mean	326.9	327.7	343.0	333.0	329.1	B	24.64**
	Received CE 76, not 75	N	169	470	67	69	775	A|B	50.49**
		Mean	323.3	321.2	318.0	318.4	321.1	A|B,A×B	53.88**
	Inconsistent 76 CE Data	N	162	442	253	225	1,082	A×B|A,B	3.51**
		Mean	334.5	332.9	348.4	338.0	337.8		
	Total	N	457	1,253	351	378	2,439		
		Mean	328.3	327.1	342.1	333.3	330.4		
2	Received CE 76 and 75	N	257	604	103	155	1,119		
		Mean	377.5	374.9	392.7	378.1	377.6	B	59.87**
	Received CE 76, not 75	N	108	402	60	52	622	A|B	84.57**
		Mean	388.4	378.5	394.0	388.0	382.5	A|B,A×B	82.47**
	Inconsistent 76 CE Data	N	147	386	329	256	1,118	A×B|A,B	1.74
		Mean	404.9	392.2	414.7	408.6	404.3		
	Total	N	512	1,392	492	463	2,859		
		Mean	387.6	380.8	407.6	396.1	389.1		
3	Received CE 76 and 75	N	369	833	123	114	1,439		
		Mean	417.5	410.2	428.7	428.7	415.1	B	99.00**
	Received CE 76, not 75	N	107	165	22	22	316	A|B	74.71**
		Mean	421.1	407.1	420.8	432.8	414.6	A|B,A×B	78.11**
	Inconsistent 76 CE Data	N	153	372	242	168	935	A×B|A,B	6.04**
		Mean	449.1	423.5	467.8	444.7	443.0		
	Total	N	629	1,370	387	304	2,690		
		Mean	425.8	413.4	452.7	437.9	424.7		
4	Received CE 76 and 75	N	322	657	179	58	1,216		
		Mean	437.1	434.6	448.7	453.5	438.2	B	54.30**
	Received CE 76, not 75	N	104	147	25	5	281	A|B	113.47**
		Mean	447.8	437.0	467.6	482.6	444.5	A|B,A×B	83.94**
	Inconsistent 76 CE Data	N	122	293	227	69	711	A×B|A,B	1.30
		Mean	470.0	464.2	490.4	494.1	476.5		
	Total	N	548	1,097	431	132	2,208		
		Mean	446.4	442.8	471.8	475.8	451.3		
5	Received CE 76 and 75	N	317	621	194	78	1,210		
		Mean	462.9	459.5	470.7	488.2	464.0	B	48.92**
	Received CE 76, not 75	N	65	110	53	19	247	A|B	54.22**
		Mean	469.2	475.9	485.7	509.0	478.8	A|B,A×B	46.92**
	Inconsistent 76 CE Data	N	105	244	178	91	618	A×B|A,B	4.39**
		Mean	487.6	475.6	515.8	510.2	494.3		
	Total	N	487	975	425	188	2,075		
		Mean	469.1	465.4	491.5	501.0	474.8		
6	Received CE 76 and 75	N	370	527	169	74	1,140		
		Mean	490.9	479.1	498.0	507.4	487.6	B	106.56**
	Received CE 76, not 75	N	79	104	36	26	245	A|B	64.38**
		Mean	489.5	481.6	498.8	513.5	490.0	A|B,A×B	72.99**
	Inconsistent 76 CE Data	N	98	208	192	205	703	A×B|A,B	3.48**
		Mean	521.5	499.8	525.4	563.5	528.4		
	Total	N	547	839	397	305	2,088		
		Mean	496.2	484.6	511.3	545.6	501.6		

*Notations: A×B - interaction effect; A|B (A|B, A×B) - A effect conditional on B (B and A×B) effect(s).

**F-test is significant at .01 level.

Table E-5

Average Pretest VSS in Reading for Reading CE Students by Participation History and Cost Levels of Instructional Services Received

GRADE	Reading CE Status in 1975-1977 School Years (A)		Cost of Services in Categories Defined by the Mean and ±1 Standard Deviation of Costs for CE Students (B)					ANOVA Test Statistics	
			High	High Average	Low Average	Low	Total	Effect*	F
1	Received CE 76 and 75	N	93	185	235	69	582	B	5.56**
		Mean	327.7	328.1	331.0	327.1	329.1	$A \mid B$	63.33**
	Received CE 76, not 75	N	166	217	329	54	766	$A \mid B, A\times B$	35.49**
		Mean	321.5	320.4	320.7	323.2	321.0	$A\times B \mid A, B$	1.35
	Inconsistent 76 CE Data	N	100	250	523	193	1,066		
		Mean	328.8	338.3	339.4	338.0	337.9		
	Total	N	359	652	1,087	316	2,414		
		Mean	325.1	329.5	332.0	333.1	330.4		
2	Received CE 76 and 75	N	172	378	468	98	1,116	B	19.71**
		Mean	374.3	376.1	380.7	375.5	377.7	$A \mid B$	112.08**
	Received CE 76, not 75	N	121	201	256	42	620	$A \mid B, A\times B$	81.72**
		Mean	378.8	383.0	382.6	390.5	382.5	$A\times B \mid A, B$	1.68
	Inconsistent 76 CE data	N	90	242	530	216	1,078		
		Mean	392.1	400.5	405.1	413.0	404.5		
	Total	N	383	821	1,254	356	2,814		
		Mean	379.9	385.0	391.4	400.0	389.0		
3	Received CE 76 and 75	N	273	448	553	120	1,394	B	32.40**
		Mean	409.6	413.2	416.7	423.3	414.7	$A \mid B$	92.81**
	Received CE 76, not 75	N	62	111	120	22	315	$A \mid B, A\times B$	45.42**
		Mean	407.2	420.6	409.0	436.0	414.6	$A\times B \mid A, B$	3.65
	Inconsistent 76 CE Data	N	65	142	472	204	883		
		Mean	416.3	438.6	446.0	448.1	443.2		
	Total	N	400	701	1,145	346	2,592		
		Mean	410.3	419.5	428.0	438.8	424.4		
4	Received CE 76 and 75	N	235	391	464	107	1,197	B	34.09**
		Mean	434.4	432.7	443.6	445.2	438.4	$A \mid B$	104.98**
	Received CE 76, not 75	N	59	82	101	24	266	$A \mid B, A\times B$	67.76**
		Mean	442.2	439.6	449.0	440.8	443.9	$A\times B \mid A, B$	1.01
	Inconsistent 76 CE Data	N	47	146	273	201	667		
		Mean	456.5	463.2	480.7	481.7	475.5		
	Total	N	341	619	838	332	2,130		
		Mean	438.8	440.8	456.4	467.0	450.7		
5	Received CE 76 and 75	N	217	395	480	97	1,189	B	41.98**
		Mean	449.4	463.0	468.8	478.9	464.2	$A \mid B$	47.65**
	Received CE 76, not 75	N	43	77	94	19	233	$A \mid B, A\times B$	37.16**
		Mean	479.1	463.9	483.6	503.9	477.9	$A\times B \mid A, B$	1.94
	Inconsistent 76 CE Data	N	41	114	288	139	582		
		Mean	474.4	480.9	493.7	513.3	494.5		
	Total	N	301	586	862	255	2,004		
		Mean	457.1	466.6	478.7	499.5	474.6		
6	Received CE 76 and 75	N	228	360	458	64	1,110	B	65.53**
		Mean	483.7	483.9	491.2	500.8	487.8	$A \mid B$	67.79**
	Received CE 76, not 75	N	35	88	86	26	235	$A \mid B, A\times B$	30.16**
		Mean	496.0	479.1	491.7	512.4	489.9	$A\times B \mid A, B$	4.95**
	Inconsistent 76 CE Data	N	37	117	332	185	671		
		Mean	482.0	503.5	527.9	553.8	528.3		
	Total	N	300	565	876	275	2,016		
		Mean	484.9	487.2	505.2	537.5	501.5		

*Notations: $A\times B$ - interaction effect; $A \mid B$ ($A \mid B$, $A\times B$) - A effect conditional on B (B and $A\times B$) effect(s).

**F-test is significant at .01 level.

Table E-6

Average Pretest VSS in Math for Math CE Students by Participation History and Intensity of Math Services Received

GRADE	Math CE Status in 1975-1977 School Years (A)		Amount of Services Received from Special Teachers and in Small Groups/Amount of Services Received in Less Intensive Settings (B)					ANOVA Test Statistics	
			High/High	High/Low	Low/High	Low/Low	Total	Effect*	F
1	Received CE 76 and 75	N	32	353	21	26	432	B	38.78**
		Mean	313.2	314.4	333.4	331.7	316.3	A|B	11.05**
	Received CE 76, not 75	N	26	197	10	14	247	A|B,A×B	11.28**
		Mean	312.7	306.1	292.9	311.6	306.6	A×B|A,B	2.52
	Inconsistent 76 CE Data	N	85	332	158	157	732		
		Mean	310.4	317.0	339.7	337.3	325.5		
	Total	N	143	882	189	197	1,411		
		Mean	311.4	313.5	336.6	334.7	319.4		
2	Received CE 76 and 75	N	45	286	60	81	472	B	6.18**
		Mean	359.4	361.6	372.3	363.9	363.1	A|B	38.48**
	Received CE 76, not 75	N	66	115	17	28	226	A|B,A×B	25.79**
		Mean	367.1	363.5	388.6	374.9	367.9	A×B|A,B	1.17
	Inconsistent 76 CE Data	N	118	306	193	263	880		
		Mean	383.6	384.3	383.8	387.8	385.1		
	Total	N	229	707	270	372	1,578		
		Mean	374.1	371.7	381.5	381.6	376.1		
3	Received CE 76 and 75	N	123	387	93	19	622	B	13.00**
		Mean	413.8	406.5	412.1	400.3	408.6	A|B	25.57**
	Received CE 76, not 75	N	95	115	33	16	259	A|B,A×B	14.15**
		Mean	406.7	414.7	416.0	417.3	412.1	A×B|A,B	1.95
	Inconsistent 76 CE Data	N	96	365	234	65	760		
		Mean	420.6	422.3	440.4	422.5	427.7		
	Total	N	314	867	360	100	1,641		
		Mean	413.7	414.2	430.9	417.5	418.0		
4	Received CE 76 and 75	N	123	303	121	16	563	B	23.90**
		Mean	440.9	445.3	451.5	458.5	446.1	A|B	54.36**
	Received CE 76, not 75	N	58	109	34	13	214	A|B,A×B	35.90**
		Mean	454.4	449.3	467.7	436.3	452.8	A×B|A,B	1.71
	Inconsistent 76 CE Data	N	86	236	232	92	646		
		Mean	467.7	472.6	493.3	495.4	482.6		
	Total	N	267	648	387	121	1,423		
		Mean	452.4	455.9	478.0	484.2	463.7		
5	Received CE 76 and 75	N	144	254	102	48	548	B	30.02**
		Mean	477.8	474.4	508.0	499.5	483.8	A|B	33.27**
	Received CE 76, not 75	N	59	108	37	25	229	A|B,A×B	23.38**
		Mean	497.3	485.0	494.2	527.6	494.3	A×B|A,B	1.45
	Inconsistent 76 CE Data	N	59	260	176	93	588		
		Mean	504.2	504.6	528.1	529.1	515.5		
	Total	N	262	622	315	166	1,365		
		Mean	488.2	488.9	517.6	520.3	499.2		
6	Received CE 76 and 75	N	141	303	84	62	590	B	19.89**
		Mean	526.4	503.9	554.8	533.9	519.7	A|B	33.36**
	Received CE 76, not 75	N	35	87	18	16	156	A|B,A×B	16.58**
		Mean	499.0	540.7	571.7	558.6	536.8	A×B|A,B	6.36**
	Inconsistent 76 CE Data	N	70	337	151	151	709		
		Mean	554.6	545.8	562.0	548.4	550.7		
	Total	N	246	727	253	229	1,455		
		Mean	530.6	527.7	560.3	545.2	536.6		

*Notations: A×B - interaction effect; A|B (A|B, A×B) - A effect conditional on B (B and A×B) effect(s).

**F-test is significant at .01 level.

Table E-7

Average Pretest VSS in Math for Math CE Students by Participation History and Cost Levels of Instructional Services Received

GRADE	Math CE Status in 1975-1977 School Years (A)		Cost of Services in Categories Defined by the Mean and ±1 Standard Deviation of Costs for CE Students (B)					ANOVA Test Statistics	
			High	High Average	Low Average	Low	Total	Effect*	F
1	Received CE 76 and 75	N	57	166	186	23	432	B	18.23**
		Mean	315.9	315.4	316.2	324.0	316.3	A|B	20.22**
	Received CE 76, not 75	N	45	84	102	15	246	A|B,A×B	5.78**
		Mean	299.4	307.0	306.2	324.5	306.4	A×B|A,B	3.89**
	Inconsistent 76 CE Data	N	57	169	381	123	730		
		Mean	294.7	326.4	326.8	334.9	325.5		
	Total	N	159	419	669	161	1,408		
		Mean	303.6	318.1	320.7	332.3	319.3		
2	Received CE 76 and 75	N	84	164	183	37	468	B	7.01**
		Mean	356.4	363.1	365.7	365.9	363.1	A|B	39.22**
	Received CE 76, not 75	N	61	65	97	3	226	A|B,A×B	30.26**
		Mean	364.4	364.0	372.4	375.3	367.9	A×B|A,B	0.62
	Inconsistent 76 CE Data	N	70	188	484	108	850		
		Mean	380.4	387.5	383.7	393.2	385.5		
	Total	N	215	417	764	148	1,544		
		Mean	366.5	374.2	378.0	386.0	376.1		
3	Received CE 76 and 75	N	116	188	260	38	602	B	12.75**
		Mean	401.8	407.5	414.5	394.2	408.6	A|B	21.40**
	Received CE 76, not 75	N	79	80	89	11	259	A|B,A×B	17.00**
		Mean	417.5	406.6	411.9	415.5	412.1	A×B|A,B	3.01**
	Inconsistent 76 CE Data	N	32	143	402	117	694		
		Mean	424.3	410.8	432.4	429.7	427.1		
	Total	N	227	411	751	166	1,555		
		Mean	410.4	408.5	423.8	420.6	417.5		
4	Received CE 76 and 75	N	118	177	242	16	553	B	17.63**
		Mean	437.9	448.1	449.9	454.1	446.9	A|B	48.47**
	Received CE 76, not 75	N	30	57	107	8	202	A|B,A×B	18.01**
		Mean	451.9	460.6	449.6	468.3	453.8	A×B|A,B	1.43
	Inconsistent 76 CE Data	N	33	112	373	86	604		
		Mean	447.1	481.6	482.6	493.8	482.1		
	Total	N	181	346	722	110	1,359		
		Mean	441.9	461.0	466.8	486.1	463.6		
5	Received CE 76 and 75	N	109	148	258	31	546	B	20.02**
		Mean	474.4	483.5	484.2	513.2	483.7	A|B	29.93**
	Received CE 76, not 75	N	38	78	97	11	224	A|B,A×B	8.52**
		Mean	486.3	499.7	487.3	542.7	494.2	A×B|A,B	2.53
	Inconsistent 76 CE Data	N	28	132	301	81	542		
		Mean	468.3	515.2	515.6	530.7	515.3		
	Total	N	175	358	656	123	1,312		
		Mean	476.0	498.7	499.1	527.4	498.6		
6	Received CE 76 and 75	N	130	144	291	20	585	B	8.43**
		Mean	516.5	512.9	522.9	550.7	520.0	A|B	31.08**
	Received CE 76, not 75	N	33	52	64	5	154	A|B,A×B	10.06**
		Mean	509.2	550.3	539.0	560.0	537.1	A×B|A,B	2.26
	Inconsistent 76 CE Data	N	42	119	444	93	698		
		Mean	536.5	556.9	550.7	552.5	551.1		
	Total	N	205	315	799	118	1,437		
		Mean	519.5	535.7	539.6	552.5	536.9		

*Notations: A×B - interaction effect; A|B (A|B, A×B) - A effect conditional on B (B and A×B) effect(s).

**F-test is significant at .01 level.

Table E-8

ANOVA of Three Different Measures of Reading Achievement Gain for Reading CE Students by Exposure to Reading CE in the Preceding Year and Intensity of Reading Service, and ANCOVA of Gains by Exposure to Reading CE in the Preceding Year, with Amounts of Reading Services as the Covariate †

G R A D E	Reading CE Status in 1975-1977 School Years (A)	Amount of Services Received by Special Teachers and in Small Groups/Amount of Services Received in Less Intensive Settings (B)					ANOVA Test Statistics		ANCOVA Test Statistics, Hours of Instruction in Three Settings as Covariates		
		High/ High	High/ Low	Low/ High	Low/ Low	Total	Effect*	F	Adjusted Means	F-Test for Equality of Adjusted Means	F-Test for Equality of Slopes
		Mean Gains in Terms of Standardized (z) Scores									
1	Received CE 76 and 75	0.247	-0.020	-0.139	-0.092	0.021	B	4.89**	0.031		
	Received CE 76, not 75	0.203	0.026	0.042	-0.027	0.061	A|B	8.21**	0.064	10.38**	
	Inconsistent 76 CE Data	-0.109	-0.112	-0.058	-0.124	-0.101	A|B,A×B	6.08**	-0.109		
	Total	0.104	-0.035	-0.046	-0.099	-0.021	A×B|A,B	1.50			4.64**
2	Received CE 76 and 75	0.016	0.058	0.005	0.086	0.048	B	1.05	0.049		
	Received CE 76, not 75	0.055	0.104	0.149	0.038	0.094	A|B	2.81	0.097	3.48	
	Inconsistent 76 CE Data	-0.022	0.024	-0.007	0.032	0.011	A|B,A×B	1.92	0.007		
	Total	0.013	0.062	0.015	0.051	0.043	A×B|A,B	0.27			1.05
3	Received CE 76 and 75	0.074	0.097	0.076	0.035	0.084	B	2.23	0.081		
	Received CE 76, not 75	0.138	0.027	0.143	-0.097	0.064	A|B	6.63**	0.062	6.59**	
	Inconsistent 76 CE Data	0.033	-0.014	-0.058	0.010	-0.013	A|B,A×B	4.04	-0.007		
	Total	0.074	0.059	-0.004	0.012	0.048	A×B|A,B	1.23			0.88
4	Received CE 76 and 75	0.010	0.064	-0.127	0.065	0.022	B	2.55	0.020		
	Received CE 76, not 75	0.050	0.032	-0.092	-0.126	0.025	A|B	0.10	0.019	0.15	
	Inconsistent 76 CE Data	-0.026	-0.020	0.019	0.064	-0.001	A|B,A×B	0.16	0.005		
	Total	0.010	0.037	-0.048	0.058	0.015	A×B|A,B	2.08			1.41
5	Received CE 76 and 75	0.031	0.031	-0.037	-0.023	0.017	B	2.09	0.013		
	Received CE 76, not 75	0.047	0.085	-0.068	0.151	0.047	A|B	1.87	0.047	1.72	
	Inconsistent 76 CE Data	0.029	-0.043	-0.038	-0.019	-0.026	A|B,A×B	1.39	-0.018		
	Total	0.033	0.019	-0.041	-0.004	0.008	A×B|A,B	0.86			1.84
6	Received CE 76 and 75	0.062	0.020	0.049	-0.013	0.036	B	0.77	0.031		
	Received CE 76, not 75	-0.014	0.094	0.028	0.219	0.063	A|B	3.45	0.059	2.36	
	Inconsistent 76 CE Data	-0.019	-0.019	0.009	-0.041	-0.018	A|B,A×B	3.82	-0.009		
	Total	0.037	0.020	0.028	-0.012	0.021	A×B|A,B	1.49			2.40
		Mean Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending Non-CE Schools									
1	Received CE 76 and 75	23.01	8.37	7.13	5.92	11.12	B	9.01**	11.90		
	Received CE 76, not 75	15.32	6.44	5.04	-1.06	7.59	A|B	46.15**	7.62	51.87**	
	Inconsistent 76 CE Data	-6.18	-6.47	-0.18	-5.59	-4.77	A|B,A×B	29.92**	-5.21		
	Total	9.82	2.41	1.46	-2.21	2.95	A×B|A,B	3.04**			4.69**
2	Received CE 76 and 75	-1.56	-3.02	1.70	0.81	-1.72	B	2.25	-1.18		
	Received CE 76, not 75	2.65	0.46	10.40	1.65	1.90	A|B	2.73	2.57	2.69	
	Inconsistent 76 CE Data	1.14	-1.95	1.13	1.62	0.18	A|B,A×B	1.91	-0.73		
	Total	0.10	-1.72	2.38	1.35	-0.19	A×B|A,B	0.41			0.99
3	Received CE 76 and 75	1.52	-0.68	3.71	0.65	0.37	B	2.50	0.76		
	Received CE 76, not 75	5.66	-4.25	4.55	-7.84	-0.53	A|B	17.40**	-0.29	20.55**	
	Inconsistent 76 CE Data	-5.22	-8.39	-6.69	-5.00	-6.82	A|B,A×B	13.54**	-7.51		
	Total	0.59	-3.20	-2.75	-3.09	-2.24	A×B|A,B	1.11			1.37
4	Received CE 76 and 75	-0.89	1.78	-8.87	3.09	-0.43	B	1.64	-0.42		
	Received CE 76, not 75	2.63	-1.52	0.58	-4.65	0.15	A|B	1.73	0.02	1.84	
	Inconsistent 76 CE Data	-4.69	-6.51	-0.99	2.95	-3.52	A|B,A×B	0.16	-3.48		
	Total	-1.07	-0.88	-4.17	2.72	-1.35	A×B|A,B	2.78			1.16
5	Received CE 76 and 75	21.66	20.62	17.22	21.81	20.43	B	5.13**	20.39		
	Received CE 76, not 75	0.75	6.55	-5.25	6.80	2.51	A|B	95.31**	2.50	92.65**	
	Inconsistent 76 CE Data	0.30	-5.53	-3.20	-0.95	-3.19	A|B,A×B	67.18**	-3.12		
	Total	14.26	12.49	5.87	9.28	11.26	A×B|A,B	0.95			1.67
6	Received CE 76 and 75	-1.13	-8.04	-3.39	-6.30	-4.99	B	3.24	-5.16		
	Received CE 76, not 75	-7.90	-2.25	-3.84	10.38	-2.96	A|B	0.34	-2.96	0.50	
	Inconsistent 76 CE Data	-4.78	-7.93	-3.71	-0.79	-4.26	A|B,A×B	0.87	-3.99		
	Total	-2.76	-7.29	-3.59	-1.18	-4.51	A×B|A,B	1.52			2.93**
		Mean Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending CE Schools									
1	Received CE 76 and 75	26.34	12.08	11.86	10.20	14.88	B	11.12**	15.79		
	Received CE 76, not 75	11.68	1.19	-0.46	-5.20	2.76	A|B	82.51**	2.77	91.46**	
	Inconsistent 76 CE Data	-8.43	-10.13	-2.15	-9.59	-7.90	A|B,A×B	51.43**	-8.39		
	Total	8.59	0.16	-0.59	-4.39	0.93	A×B|A,B	2.88**			4.31**
2	Received CE 76 and 75	-3.45	-4.55	1.85	-0.42	-3.13	B	0.59	-2.71		
	Received CE 76, not 75	4.83	4.21	11.69	3.35	4.97	A|B	13.07**	5.48	13.24**	
	Inconsistent 76 CE Data	-0.51	-2.76	-1.86	-0.16	-1.60	A|B,A×B	6.80**	-2.31		
	Total	-0.86	-1.52	0.57	0.15	-0.77	A×B|A,B	0.64			1.82
3	Received CE 76 and 75	3.03	2.59	3.29	1.29	2.66	B	3.45	2.84		
	Received CE 76, not 75	7.36	-0.61	6.42	-6.18	2.19	A|B	21.93**	2.38	26.17**	
	Inconsistent 76 CE Data	-4.34	-6.22	-8.23	-4.59	-6.14	A|B,A×B	16.70**	-6.47		
	Total	1.97	-0.18	-3.74	-2.50	-0.45	A×B|A,B	1.17			1.83
4	Received CE 76 and 75	3.96	5.74	-0.88	9.79	4.49	B	0.90	4.60		
	Received CE 76, not 75	1.21	-6.00	1.22	-4.33	-2.66	A|B	14.26**	-2.61	14.48**	
	Inconsistent 76 CE Data	-5.13	-6.53	-0.95	1.11	-3.77	A|B,A×B	6.65**	-3.99		
	Total	1.41	0.89	-0.79	4.72	0.92	A×B|A,B	1.91			0.46
5	Received CE 76 and 75	0.87	-0.66	-2.08	-0.22	-0.46	B	0.57	-0.42		
	Received CE 76, not 75	1.67	7.50	-1.11	13.22	4.56	A|B	3.80	4.54	3.90	
	Inconsistent 76 CE Data	0.38	-4.58	-1.87	-1.70	-2.53	A|B,A×B	2.97	-2.59		
	Total	0.87	-0.72	-1.87	0.42	-0.48	A×B|A,B	0.90			1.58
6	Received CE 76 and 75	10.72	5.20	10.31	4.10	7.68	B	2.36	7.35		
	Received CE 76, not 75	-1.94	6.63	2.84	12.75	3.96	A|B	14.94**	3.74	12.27**	
	Inconsistent 76 CE Data	-2.67	-3.19	0.04	-3.23	-2.25	A|B,A×B	12.68**	-1.65		
	Total	6.49	3.30	4.66	-0.09	3.90	A×B|A,B	1.47			1.97

† Numbers of cases in each cell and in marginals can be found in Table E-4 of Appendix E.

* Notations: A×B - interaction effect; A|B (A|B, A×B) - A effect conditional on B (B and A×B) effect(s).

** F-test is significant at .01 level.

Table E-9

Two-Way ANOVAs of Three Different Measures of Reading Achievement for Reading CE Students by Exposure to Reading CE in the Preceding Year and by Cost Levels of Instructional Services†

GRADE	Reading CE Status in 1975-1977 School Years (A)	Cost of Services in Categories Defined by the Mean and ±1 Standard Deviation of Costs for CE Students (B)					ANOVA Test Statistics	
		High	High Average	Low Average	Low	Total	Effect*	F
		Mean Gains in Terms of Standardized (z) Scores						
1	Received CE 76 and 75	−0.156	0.154	−0.006	−0.005	0.021	B	1.74
	Received CE 76, not 75	0.078	0.071	0.066	−0.045	0.062	A|B	9.45**
	Inconsistent 76 CE Data	−0.207	−0.064	−0.118	−0.028	−0.097	A|B,A×B	5.20**
	Total	−0.062	0.043	−0.038	−0.026	−0.018	A×B|A,B	1.41
2	Received CE 76 and 75	−0.031	0.006	0.117	0.017	0.048	B	2.29
	Received CE 76, not 75	0.148	0.050	0.135	−0.074	0.096	A|B	2.83
	Inconsistent 76 CE Data	−0.050	0.075	0.016	−0.022	0.016	A|B,A×B	1.05
	Total	0.021	0.037	0.078	−0.017	0.046	A×B|A,B	1.92
3	Received CE 76 and 75	0.064	0.087	0.096	0.124	0.089	B	2.30
	Received CE 76, not 75	0.038	0.114	0.061	−0.098	0.064	A|B	7.20**
	Inconsistent 76 CE Data	0.083	0.070	−0.029	−0.066	−0.014	A|B,A×B	3.92
	Total	0.063	0.088	0.040	−0.002	0.051	A×B|A,B	1.50
4	Received CE 76 and 75	0.059	0.024	−0.004	0.060	0.023	B	1.51
	Received CE 76, not 75	0.045	0.197	−0.076	−0.056	0.037	A|B	0.46
	Inconsistent 76 CE Data	0.007	−0.018	−0.012	0.020	−0.002	A|B,A×B	0.56
	Total	0.050	0.037	−0.015	0.027	0.017	A×B|A,B	1.58
5	Received CE 76 and 75	0.002	0.039	0.012	−0.017	0.016	B	0.69
	Received CE 76, not 75	0.029	0.073	0.020	0.067	0.043	A|B	1.52
	Inconsistent 76 CE Data	−0.009	−0.027	−0.019	−0.028	−0.022	A|B,A×B	1.16
	Total	0.005	0.030	0.002	−0.017	0.008	A×B|A,B	0.16
6	Received CE 76 and 75	0.113	0.056	−0.008	0.002	0.038	B	6.17**
	Received CE 76, not 75	0.030	0.101	0.038	0.120	0.070	A|B	2.08
	Inconsistent 76 CE Data	0.110	−0.002	−0.021	−0.059	−0.021	A|B,A×B	1.20
	Total	0.103	0.051	−0.008	−0.028	0.022	A×B|A,B	0.73
		Mean Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending Non-CE Schools						
1	Received CE 76 and 75	2.14	16.65	11.68	6.49	11.12	B	3.92**
	Received CE 76, not 75	7.15	8.75	8.26	1.11	7.65	A|B	47.52**
	Inconsistent 76 CE Data	−12.13	−2.45	−4.92	−2.79	−4.63	A|B,A×B	31.53**
	Total	0.48	6.70	2.66	−0.10	3.06	A×B|A,B	1.62
2	Received CE 76 and 75	−9.05	−3.36	2.76	−3.30	−1.67	B	4.12**
	Received CE 76, not 75	2.22	−0.11	4.26	−2.09	2.02	A|B	2.73
	Inconsistent 76 CE Data	−5.09	4.63	0.30	−0.59	0.64	A|B,A×B	2.64
	Total	−4.56	−0.21	2.03	−1.51	0.03	A×B|A,B	2.36
3	Received CE 76 and 75	−3.76	1.18	1.88	2.57	0.61	B	3.31
	Received CE 76, not 75	−5.39	3.64	−1.58	−2.23	−0.53	A|B	18.22**
	Inconsistent 76 CE Data	−5.04	−3.74	−7.89	−8.57	−7.17	A|B,A×B	9.30**
	Total	−4.22	0.57	−2.51	−4.30	−2.18	A×B|A,B	1.18
4	Received CE 76 and 75	1.85	−0.54	−1.99	3.27	−0.29	B	1.30
	Received CE 76, not 75	−0.34	10.32	−4.91	−4.47	0.84	A|B	2.48
	Inconsistent 76 CE Data	−6.66	−4.04	−4.16	−2.18	−3.71	A|B,A×B	2.96
	Total	0.30	0.07	−3.05	−0.59	−1.22	A×B|A,B	1.60
5	Received CE 76 and 75	17.89	21.27	21.05	19.54	20.42	B	3.63
	Received CE 76, not 75	1.02	4.44	−0.56	3.45	1.71	A|B	92.09**
	Inconsistent 76 CE Data	−4.39	−0.68	−3.87	−1.57	−2.73	A|B,A×B	59.59**
	Total	12.44	14.79	10.37	6.83	11.52	A×B|A,B	0.23
6	Received CE 76 and 75	0.03	−3.37	−7.93	−5.68	−4.69	B	2.05
	Received CE 76, not 75	−6.31	−0.35	−4.29	3.40	−2.27	A|B	0.60
	Inconsistent 76 CE Data	0.87	−5.94	−4.21	−4.56	−4.33	A|B,A×B	0.32
	Total	−0.61	−3.44	−6.1[illegible]	[illegible]	−4.29	A×B|A,B	0.82
		Mean Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending CE Schools						
1	Received CE 76 and 75	8.60	19.84	14.67	10.80	14.88	B	4.60**
	Received CE 76, not 75	3.97	3.85	2.47	−3.21	2.79	A|B	80.09**
	Inconsistent 76 CE Data	−14.28	−4.45	−8.63	−6.23	−7.75	A|B,A×B	58.38**
	Total	0.08	5.21	−0.33	−2.00	1.05	A×B|A,B	1.41
2	Received CE 76 and 75	−10.18	−5.37	1.71	−5.06	−3.08	B	3.21
	Received CE 76, not 75	6.26	2.78	7.27	−0.72	5.08	A|B	12.17**
	Inconsistent 76 CE Data	−4.58	3.38	−1.99	−3.39	−1.28	A|B,A×B	8.32**
	Total	−3.67	−0.75	1.28	−3.53	−0.59	A×B|A,B	3.04**
3	Received CE 76 and 75	−1.00	3.38	4.10	4.70	2.92	B	3.85**
	Received CE 76, not 75	−2.08	5.57	1.85	−0.78	2.20	A|B	24.49**
	Inconsistent 76 CE Data	−2.06	−2.00	−7.27	−8.55	−6.33	A|B,A×B	12.09**
	Total	−1.34	2.64	−0.82	−3.46	−0.32	A×B|A,B	1.54
4	Received CE 76 and 75	6.13	3.30	4.05	9.10	4.66	B	0.65
	Received CE 76, not 75	−3.26	6.29	−6.92	−9.32	−2.25	A|B	14.56**
	Inconsistent 76 CE Data	−5.59	−5.20	−3.97	−3.53	−4.22	A|B,A×B	14.44**
	Total	2.89	1.69	0.12	0.12	1.02	A×B|A,B	1.62
5	Received CE 76 and 75	−4.09	0.52	0.67	−2.31	−0.49	B	0.74
	Received CE 76, not 75	3.37	3.32	3.38	7.36	3.69	A|B	2.82
	Inconsistent 76 CE Data	−3.78	−2.86	−2.15	−1.46	−2.24	A|B,A×B	2.48
	Total	−2.97	0.23	0.02	−1.13	−0.51	A×B|A,B	0.25
6	Received CE 76 and 75	12.76	9.44	4.48	5.99	7.88	B	7.46**
	Received CE 76, not 75	1.48	7.16	1.89	6.91	4.36	A|B	11.07**
	Inconsistent 76 CE Data	5.44	−1.58	−2.84	−3.93	−2.46	A|B,A×B	7.15**
	Total	10.54	6.80	1.45	−0.60	4.03	A×B|A,B	0.50

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† Numbers of cases in each cell and in marginals can be found in Table E-5 of Appendix E.

* Notations: A×B - interaction effect; A|B (A|B, A×B) - A effect conditional on B (B and A×B) effect(s).

** F-test is significant at .01 level.

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Table E-10

AMOVA of Three Different Measures of Math Achievement Gain for Math CE Students by Exposure to Math CE in the Preceding Year and Intensity of Math Service, and ANCOVA of Gains by Exposure to Math CE in the Preceding Year, with Amounts of Math Services as the Covariate†

GRADE	Math CE Status in 1975-1977 School Years (A)	Amount of Services Received by Special Teachers and in Small Groups/Amount of Services Received in Less Intensive Settings (B)					ANOVA Test Statistics		ANCOVA Test Statistics, Hours of Instruction in Three Settings as Covariates		
		High/ High	High/ Low	Low/ High	Low/ Low	Total	Effect*	F	Adjusted Means	F-Test for Equality of Adjusted Means	F-Test for Equality of Slopes
		Mean Gains in Terms of Standardized (z) Scores									
1	Received CE 76 and 75	0.176	0.191	-0.409	-0.047	0.147	B	13.00**	.029		
	Received CE 76, not 75	-0.016	0.040	0.488	-0.032	0.048	A|B	1.86	.027	4.26	
	Inconsistent 76 CE Data	0.140	0.080	-0.279	-0.197	-0.050	A|B,AxB	1.47	-.032		
	Total	0.120	0.116	-0.253	-0.165	0.028	AxB|A,B	1.77			2.54
2	Received 76 and 75	0.258	-0.074	0.050	0.030	-0.009	B	0.76	-0.002		
	Received 76, not 75	0.029	-0.033	-0.447	0.373	0.004	A|B	0.02	0.007	0.04	
	Inconsistent 76 CE Data	-0.028	0.014	-0.012	-0.014	-0.006	A|B,AxB	1.08	-0.010		
	Total	0.045	-0.029	-0.025	0.025	-0.005	AxB|A,B	2.99**			4.80**
3	Received CE 76 and 75	-0.006	0.091	0.202	0.132	0.090	B	3.32	0.096		
	Received CE 76, not 75	0.225	0.093	0.221	-0.334	0.131	A|B	4.79**	0.130	3.96	
	Inconsistent 76 CE Data	0.128	-0.098	0.103	0.010	0.001	A|B,AxB	0.65	-0.003		
	Total	0.105	0.012	0.139	-0.022	0.055	AxB|A,B	2.47			4.15**
4	Received CE 76 and 75	0.201	0.062	-0.266	-0.128	0.016	B	7.85**	-0.019		
	Received CE 76, not 75	0.196	-0.021	0.102	-0.043	0.056	A|B	0.88	0.043	0.80	
	Inconsistent 76 CE Data	-0.079	-0.010	-0.098	-0.040	-0.055	A|B,AxB	1.47	-0.020		
	Total	0.110	0.022	-0.133	-0.051	-0.010	AxB|A,B	3.41**			6.48**
5	Received CE 76 and 75	0.105	0.113	-0.062	0.016	0.070	B	4.51**	0.058		
	Received CE 76, not 75	0.331	0.104	0.134	0.004	0.156	A|B	3.62	0.135	2.60	
	Inconsistent 76 CE Data	0.148	-0.021	0.020	-0.055	0.003	A|B,AxB	2.46	0.022		
	Total	0.166	0.055	0.007	-0.025	0.055	AxB|A,B	1.54			0.94
6	Received CE 76 and 75	0.043	0.155	0.061	0.018	0.100	B	1.93	0.086		
	Received CE 76, not 75	0.221	0.013	-0.049	-0.161	0.035	A|B	4.18	0.009	2.38	
	Inconsistent 76 CE Data	-0.080	0.004	0.073	-0.050	-0.001	A|B,AxB	2.22	0.016		
	Total	0.033	0.068	0.060	-0.039	0.044	AxB|A,B	1.73			2.55
		Mean Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending Non-CE Schools									
1	Received CE 76 and 75	19.25	19.05	-0.74	24.12	18.41	B	9.57**	18.32		
	Received CE 76, not 75	6.57	6.36	17.47	6.65	6.85	A|B	20.85**	6.47	[illegible]7.77**	
	Inconsistent 76 CE Data	4.41	5.12	-4.27	-2.81	1.31	A|B,AxB	9.95**	1.49		
	Total	8.12	10.97	-2.73	1.42	7.51	AxB|A,B	1.29			3.09**
2	Received CE 76 and 75	13.18	-2.55	7.53	4.75	1.48	B	1.28	2.01		
	Received CE 76, not 75	6.62	-1.37	-13.90	24.82	3.26	A|B	0.48	3.79	1.03	
	Inconsistent 76 CE Data	-0.56	3.74	-3.18	-0.32	0.43	A|B,AxB	2.90	0.02		
	Total	4.21	0.36	-1.47	2.68	1.15	AxB|A,B	4.42**			5.76**
3	Received CE 76 and 75	22.60	22.66	29.35	22.43	23.64	B	6.15**	24.08		
	Received CE 76, not 75	12.75	4.38	18.40	-19.91	7.74	A|B	89.00**	6.96	82.08**	
	Inconsistent 76 CE Data	0.19	-10.60	4.86	-6.14	-4.10	A|B,AxB	35.77**	-4.19		
	Total	12.77	6.23	12.43	-2.91	8.29	AxB|A,B	1.87			4.43**
4	Received CE 76 and 75	10.95	2.19	-21.76	-6.60	-1.29	B	4.90**	-2.77		
	Received CE 76, not 75	14.32	-4.41	9.44	-12.05	2.40	A|B	1.06	1.96	1.30	
	Inconsistent 76 CE Data	-11.02	-4.24	-3.33	-4.74	-4.89	A|B,AxB	1.59	-3.46		
	Total	4.60	-1.26	-7.97	-5.77	-2.37	AxB|A,B	6.72**			9.53**
5	Received CE 76 and 75	6.13	4.76	0.84	4.14	4.34	B	3.61	3.77		
	Received CE 76, not 75	28.06	9.18	9.79	6.58	13.86	A|B	7.19**	12.60	5.75**	
	Inconsistent 76 CE Data	8.87	-2.95	2.87	-3.57	-0.12	A|B,AxB	4.90**	0.90		
	Total	11.69	2.30	3.03	0.19	4.01	AxB|A,B	1.20			1.05
6	Received CE 76 and 75	5.59	11.50	24.49	9.33	11.71	B	5.32**	10.82		
	Received CE 76, not 75	13.32	5.75	12.80	-3.14	7.35	A|B	15.64**	5.62	9.38**	
	Inconsistent 76 CE Data	-7.10	-2.09	7.14	-8.04	-1.89	A|B,AxB	13.23**	-0.77		
	Total	3.08	4.51	13.31	-3.00	4.62	AxB|A,B	0.51			0.64
		Mean Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending CE Schools									
1	Received CE 76 and 75	13.13	12.31	-6.11	12.38	11.47	B	9.31**	11.35		
	Received CE 76, not 75	1.89	1.01	8.73	-0.20	1.35	A|B	17.41**	1.09	23.83**	
	Inconsistent 76 CE Data	-1.19	-0.60	-9.46	-7.68	-4.10	A|B,AxB	7.61**	-3.94		
	Total	2.58	4.93	-8.13	-4.51	1.62	AxB|A,B	0.77			3.11**
2	Received CE 76 and 75	1.45	-12.93	4.86	-4.34	-7.82	B	1.37	-7.24		
	Received CE 76, not 75	10.29	2.43	-8.78	30.26	7.33	A|B	10.49**	8.02	11.28**	
	Inconsistent 76 CE Data	-4.99	0.43	-6.10	-3.62	-2.94	A|B,AxB	5.63**	-3.42		
	Total	0.68	-4.65	-3.83	-1.23	-2.93	AxB|A,B	5.13**			8.27**
3	Received CE 76 and 75	-5.10	-3.83	1.98	-2.91	-3.18	B	8.87**	-2.64		
	Received CE 76, not 75	5.24	-2.80	8.30	-25.69	0.15	A|B	6.67**	-0.25	5.04**	
	Inconsistent 76 CE Data	-4.01	-14.61	2.12	-12.63	-7.95	A|B,AxB	1.34	-8.26		
	Total	-1.64	-8.23	2.65	-12.87	-4.86	AxB|A,B	2.01			5.21**
4	Received CE 76 and 75	3.18	-4.60	-28.48	-18.22	-8.42	B	2.87	-10.18		
	Received CE 76, not 75	3.07	-12.08	-0.61	-19.55	-6.61	A|B	1.34	-7.18	2.60	
	Inconsistent 76 CE Data	-12.36	-5.40	-4.39	-5.52	-5.98	A|B,AxB	1.04	-4.26		
	Total	-1.85	-6.15	-11.59	-8.71	-7.04	AxB|A,B	6.22**			9.09**
5	Received CE 76 and 75	3.88	3.58	-1.25	-1.39	2.32	B	5.00**	1.58		
	Received CE 76, not 75	27.84	8.23	9.13	-1.47	12.37	A|B	8.68**	10.92	6.88*	
	Inconsistent 76 CE Data	7.66	-5.71	-0.70	8.03	-3.24	A|B,AxB	5.31**	-1.97		
	Total	10.13	0.50	0.27	-5.12	1.61	AxB|A,B	1.46			1.42
6	Received CE 76 and 75	11.67	18.77	17.86	9.92	16.02	B	3.90**	15.09		
	Received CE 76, not 75	5.18	-0.16	4.39	-9.42	0.61	A|B	30.96**	-1.23	24.42**	
	Inconsistent 76 CE Data	-8.14	-5.03	6.27	-8.76	-3.72	A|B,AxB	19.79**	-2.55		
	Total	5.11	5.47	9.99	-3.75	4.75	AxB|A,B	0.76			1.81

†Numbers of cases in each cell and in marginals can be found in Table E-6 of Appendix F.

*Notations: AxB - interaction effect; A|B (A|B, AxB) - A effect conditional on B (B and AxB) effect(s).

**F-test is significant at .01 level.

Table E-11

Two-Way ANOVAs of Three Different Measures of Math Achievement for Math CE Students by Exposure to Math CE in the Preceding Year and by Cost Levels of Instructional Services†

GRADE	Math CE Status in 1975-1977 School Years (A)	Cost of Services in Categories Defined by the Mean and ±1 Standard Deviation of Costs for CE Students (B)					ANOVA Test Statistics	
		High	High Average	Low Average	Low	Total	Effect*	F
		Mean Gains in Terms of Standardized (z) Scores						
1	Received CE 76 and 75	0.284	0.210	0.135	-0.554	0.147	B	4.43**
	Received CE 76, not 75	0.108	-0.016	0.117	-0.131	0.055	A|B	4.60
	Inconsistent 76 CE Data	0.003	-0.030	-0.038	-0.135	-0.049	A|B,A×B	0.63
	Total	0.134	0.068	0.034	-0.194	0.029	A×B|A,B	1.85
2	Received CE 76 and 75	-0.108	0.087	-0.031	-0.100	-0.009	B	0.52
	Received CE 76, not 75	-0.053	-0.053	0.095	-0.516	0.004	A|B	0.04
	Inconsistent 76 CE Data	0.048	-0.059	0.006	-0.042	-0.011	A|B,A×B	0.50
	Total	-0.042	-0.001	0.008	-0.066	-0.008	A×B|A,B	1.26
3	Received CE 76 and 75	-0.022	0.106	0.101	0.237	0.087	B	1.66
	Received CE 76, not 75	0.073	0.256	0.109	-0.182	0.131	A|B	3.07
	Inconsistent 76 CE Data	-0.146	0.080	0.014	0.042	0.025	A|B,A×B	1.81
	Total	-0.006	0.126	0.055	0.072	0.067	A×B|A,B	0.84
4	Received CE 76 and 75	0.272	-0.025	-0.056	-0.189	0.020	B	9.55**
	Received CE 76, not 75	0.205	0.179	-0.020	-0.445	0.053	A|B	0.74
	Inconsistent 76 CE Data	0.127	-0.098	-0.044	-0.078	-0.049	A|B,A×B	0.08
	Total	0.235	-0.015	-0.044	-0.121	-0.006	A×B|A,B	1.48
5	Received CE 76 and 75	0.106	0.070	0.082	-0.153	0.070	B	1.93
	Received CE 76, not 75	0.221	0.199	0.099	0.114	0.155	A|B	4.06
	Inconsistent 76 CE Data	-0.042	-0.043	0.042	-0.048	0.004	A|B,A×B	3.51
	Total	0.107	0.056	0.066	-0.060	0.057	A×B|A,B	0.85
6	Received CE 76 and 75	0.230	0.071	0.075	-0.164	0.100	B	6.61**
	Received CE 76, not 75	0.275	-0.082	0.031	-0.462	0.029	A|B	2.66
	Inconsistent 76 CE Data	0.028	-0.090	0.019	-0.018	-0.004	A|B,A×B	1.30
	Total	0.196	-0.015	0.040	-0.062	0.042	A×B|A,B	1.55
		Mean Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending Non-CE Schools						
1	Received CE 76 and 75	24.04	20.36	18.88	-13.53	18.41	B	5.98**
	Received CE 76, not 75	4.88	4.01	8.73	18.38	7.01	A|B	25.65**
	Inconsistent 76 CE Data	-7.08	5.92	2.06	-3.58	1.29	A|B,A×B	11.31**
	Total	7.46	11.26	7.76	-2.96	7.54	A×B|A,B	3.67**
2	Received CE 76 and 75	-5.49	6.68	0.13	1.22	1.50	B	0.45
	Received CE 76, not 75	0.91	-2.43	9.19	-16.93	3.26	A|B	0.65
	Inconsistent 76 CE Data	4.82	-0.83	0.57	-2.03	0.28	A|B,A×B	0.13
	Total	-0.32	1.87	1.56	-1.52	1.09	A×B|A,B	1.95
3	Received CE 76 and 75	16.38	26.24	24.18	25.62	23.41	B	3.79
	Received CE 76, not 75	5.73	13.65	5.94	-6.29	7.74	A|B	73.88**
	Inconsistent 76 CE Data	-8.25	-4.12	-2.81	-5.38	-3.77	A|B,A×B	44.85**
	Total	9.20	13.22	7.57	1.66	8.67	A×B|A,B	0.63
4	Received CE 76 and 75	13.74	-4.14	-4.64	-12.08	-0.77	B	6.08**
	Received CE 76, not 75	11.10	12.75	-3.29	-24.71	2.53	A|B	1.26
	Inconsistent 76 CE Data	-1.24	-8.30	-4.28	-3.10	-4.69	A|B,A×B	0.29
	Total	10.58	-2.70	-4.25	-5.98	-2.02	A×B|A,B	2.04
5	Received CE 76 and 75	3.30	5.06	5.44	-4.24	4.36	B	0.75
	Received CE 76, not 75	18.28	18.38	7.29	19.92	13.64	A|B	8.01**
	Inconsistent 76 CE Data	-15.07	-3.64	3.31	-3.27	-0.32	A|B,A×B	9.23**
	Total	3.61	4.75	4.74	-1.44	4.01	A×B|A,B	1.68
6	Received CE 76 and 75	18.74	5.44	13.60	-7.12	12.02	B	7.14**
	Received CE 76, not 75	16.57	1.94	8.54	-24.91	6.94	A|B	11.57**
	Inconsistent 76 CE Data	4.72	-7.54	-0.61	-4.47	-1.99	A|B,A×B	3.19
	Total	15.52	-0.04	5.30	-5.79	4.67	A×B|A,B	0.63
		Mean Residual Gain Scores Based on the Estimated Regression Using Data from Non-CE Students Attending CE Schools						
1	Received CE 76 and 75	16.94	14.50	10.75	-18.12	11.47	B	5.08**
	Received CE 76, not 75	-1.76	-0.43	2.87	13.33	1.53	A|B	22.25**
	Inconsistent 76 CE Data	-14.09	0.01	-3.37	-7.47	-4.12	A|B,A×B	10.67**
	Total	0.53	5.66	1.51	-7.05	1.65	A×B|A,B	3.69**
2	Received CE 76 and 75	-17.72	-2.95	-8.25	-5.01	-7.84	B	0.72
	Received CE 76, not 75	4.85	1.73	13.47	-19.53	7.33	A|B	11.41**
	Inconsistent 76 CE Data	1.69	-2.80	-3.16	-6.63	-3.12	A|B,A×B	2.44
	Total	-4.99	-2.15	-2.27	-6.49	-3.02	A×B|A,B	2.15
3	Received CE 76 and 75	-10.46	-1.09	-2.53	0.43	-3.42	B	1.73
	Received CE 76, not 75	-2.35	6.36	-1.45	-14.11	0.15	A|B	5.04**
	Inconsistent 76 CE Data	-16.21	-7.75	-5.98	-9.48	-7.41	A|B,A×B	2.83
	Total	-8.45	-1.96	-4.25	-7.52	-4.61	A×B|A,B	0.75
4	Received CE 76 and 75	7.10	-11.10	-12.56	-21.89	-8.17	B	4.90**
	Received CE 76, not 75	0.54	2.64	-11.40	-34.95	-6.60	A|B	1.88
	Inconsistent 76 CE Data	-0.23	-8.83	-5.67	-3.82	-5.69	A|B,A×B	1.12
	Total	4.67	-8.10	-8.83	-8.71	-6.84	A×B|A,B	1.88
5	Received CE 76 and 75	2.19	3.35	3.19	-9.20	2.33	B	1.77
	Received CE 76, not 75	17.94	16.41	5.73	14.74	11.96	A|B	9.15**
	Inconsistent 76 CE Data	-17.12	-6.15	0.57	-9.02	-3.41	A|B,A×B	10.16**
	Total	2.52	2.69	2.36	-6.94	1.60	A×B|A,B	1.66
6	Received CE 76 and 75	25.10	13.09	15.14	-4.96	16.17	B	7.98**
	Received CE 76, not 75	11.85	-5.24	1.08	-29.61	0.26	A|B	25.50**
	Inconsistent 76 CE Data	-1.95	-8.64	-2.50	-4.71	-3.81	A|B,A×B	10.23**
	Total	17.43	1.86	4.21	-5.81	4.76	A×B|A,B	1.02

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† Numbers of cases in each cell and in marginals can be found in Table E-7 of Appendix E.

* Notations: A×B - interaction effect; A|B (A|B, A×B) - A effect conditional on B (B and A×B) effect(s).

** F-test is significant at .01 level.

APPENDIX F

SUPPLEMENTARY TABLES FOR CHAPTER 6

Table F-1

The Effects of Instructional Services on Reading and Math Achievement of the First Graders

Hierarchical-Stepwise Selection of Predictor Variables for Posttest Achievement Scores*	Entry Order*	Correlation with Posttest	Standard Regression Coefficient	Increase in R^2	Partial Correlation with Posttest Given the Variables of Entry Orders					
					1	1-2	1-3	1-4	1-5	1-6
Analysis for Reading (N=1,478)										
Highest Selection Level										
Pretest	1	.66	.533	.438	-					
Second Selection Level										
Judged Need in CE	2	-.49	-.196	.038	-.26	-				
Mother's Educ. Attainment	3	.31	.066	.005	.13	.10	-			
Free-Meals Participation	4	-.33	-.051	.001	-.11	-.07	-.05	-		
Third Selection Level										
Type of Instructors										
Classroom Teachers	5	.12	.068	.004	.12	.09	.09	.09	-	
(White/Minority Status)	6	.21	-.033	.001	.03	-.01	-.01	-.03	-.04	-
Special Teachers	NS	-.20	NS	NS	-.09	-.00	.00	.00	.01	.01
Aides/Asst/Tutor	NS	-.16	NS	NS	-.09	-.05	-.05	-.04	-.03	-.03
Independent Work	NS	.13	NS	NS	.03	.01	.01	.01	.02	.02
Multiple R^2 (R) for the Reg. Eq.			.487 (.698)							
Size of Instructional Group										
Approximately 7-13	5	.09	.064	.004	.10	.09	.09	.09	-	
(White/Minority Status)	NS	.21	NS	NS	.03	-.01	-.01	-.03	-.03	
14 or more	NS	.06	NS	NS	.05	.02	.02	.02	.03	
Approximately 1-6	NS	-.04	NS	NS	-.05	-.02	-.01	-.02	.02	
Multiple R^2 (R) for the Reg. Eq.			.486 (.697)							
Instructional Settings										
Regular Instruction	5	.13	.055	.003	.12	.08	.08	.08	-	
(White/Minority Status)	NS	.21	NS	NS	.03	-.01	-.01	-.03	-.03	
Special Instruction	NS	-.18	NS	NS	-.09	-.01	-.00	-.00	.04	
Tutor/Independent	NS	.11	NS	NS	.02	.00	.00	-.00	.01	
Multiple R^2 (R) for the Reg. Eq.			.484 (.696)							
Analysis for Math (N=1,430)										
Highest Selection Level										
Pretest	1	.67	.578	.445	-					
Second Selection Level										
Judged Need in CE	2	-.41	-.140	.023	-.20	-				
Free-Meals Participation	3	-.28	-.053	.004	-.12	-.08	-			
Mother's Educ. Attainment	4	.27	.037	.001	.10	.06	.05	-		
Third Selection Level										
Type of Instructors										
Special Teachers	5	-.16	-.030	.001	-.09	-.04	-.04	-.04	-	
(White/Minority Status)	NS	.21	NS	NS	.06	.02	-.01	-.01	-.01	
Classroom Teachers	NS	.01	NS	NS	.05	.03	.03	.04	.03	
Aides/Asst/Tutor	NS	-.12	NS	NS	-.04	.00	.01	.01	.01	
Independent Work	NS	.08	NS	NS	.03	.02	.01	.01	.01	
Multiple R^2 (R) for the Reg. Eq.			.474 (.688)							
Size of Instructional Group										
(White/Minority Status)	NS	.21	NS	NS	.06	.02	-.01	-.01		
14 or more	NS	.10	NS	NS	.06	.04	.03	.03		
Approximately 7-13	NS	-.10	NS	NS	-.03	-.00	.01	.01		
Approximately 1-6	NS	-.05	NS	NS	-.02	-.00	-.00	-.00		
Multiple R^2 (R) for the Reg. Eq.			.473 (.688)							
Instructional Settings										
Regular Instruction	5	.06	.029	.001	.06	.04	.04	.04	-	
(White/Minority Status)	NS	.21	NS	NS	.06	.02	-.01	-.01	-.01	
Special Instruction	NS	-.19	NS	NS	-.07	-.02	-.02	-.01	-.00	
Tutor/Independent	NS	.07	NS	NS	.03	.02	.01	.01	.01	
Multiple R^2 (R) for the Reg. Eq.			.474 (.688)							

* The forward stepwise selection procedure always enters the pretest score into the regression equation first. At the second selection level, variables describing student background characteristics are entered sequentially until none of the remaining variables has a partial F-for-inclusion exceeding 2.0. The background variables refer to race/ethnicity (1 = Caucasian/White; 0 = Non-Caucasian/White), participation in free or reduced-price meals (a proxy for economic status, 1 = participation; 0 = non-participation), teacher's judgment of CE need in the subject area (1 = need; 0 = no need), and mother's educational attainment (1 = high school graduate or above; 0 = less than high school). At the third level, *the background variables not yet entered at the second level* and a set of composite variables describing the nature and amount of instructional services received are involved in the selection. Again, these variables are entered into the equation sequentially until the partial F's for all non-entered variables are less than 2.0. Three different sets of service composites were investigated separately. Their constructions are explained in Figure 6-1. (NS = Not Selected.)

Table F-2

The Effects of Instructional Services on Reading and Math Achievement of the Second Graders

	Hierarchical-Stepwise Selection of Predictor Variables for Posttest Achievement Scores*	Entry Order*	Correlation with Posttest	Standard Regression Coefficient	Increase in R^2	Partial Correlation with Posttest Given the Variables of Entry Orders					
						1	1-2	1-3	1-4	1-5	1-6
Analysis for Reading (N=1,390)	Highest Selection Level										
	Pretest	1	.80	.660	.636	-					
	Second Selection Level										
	Judged Need in CE	2	-.56	-.151	.018	-.22	-				
	Free-Meals Participation	3	-.36	-.066	.011	-.19	-.18	-			
	White/Minority Status	4	.29	.069	.004	.17	.17	.10	-		
	Mother's Educ. Attainment	5	.32	.048	.002	.14	.12	.07	.08	-	
	Third Selection Level										
	Type of Instructors										
	Classroom Teachers	NS	.10	NS	NS	.05	.04	.04	.04	.04	
	Special Teachers	NS	-.29	NS	NS	-.10	-.01	-.01	-.01	-.01	
	Aides/Asst/Tutor	NS	-.16	NS	NS	-.04	-.01	.00	.01	.01	
	Independent Work	NS	.18	NS	NS	.04	.02	.03	.03	.02	
	Multiple R^2(R) for the Reg. Eq.			.671 (.819)							
	Size of Instructional Group										
	Approximately 7-13	6	.05	.050	.002	.05	.07	.08	.09	.09	-
	14 or more	NS	.09	NS	NS	.03	.01	.00	.01	.00	.03
	Approximately 1-6	NS	-.04	NS	NS	-.04	-.02	-.02	-.02	-.03	-.01
	Multiple R^2(R) for the Reg. Eq.			.673 (.820)							
	Instructional Settings										
	Regular Instruction	6	.15	.039	.002	.08	.06	.07	.07	.07	-
	Special Instruction	NS	-.26	NS	NS	-.10	-.03	-.04	-.04	-.04	-.02
	Tutor/Independent	NS	.16	NS	NS	.03	.01	.02	.02	.01	.02
	Multiple R^2(R) for the Reg. Eq.			.672 (.820)							
Analysis for Math (N=1,375)	Highest Selection Level										
	Pretest	1	.72	.649	.525	-					
	Second Selection Level										
	Judged Need in CE	2	-.43	-.127	.016	-.19	-				
	Mother's Educ. Attainment	3	.24	.062	.004	.12	.09	-			
	White/Minority Status	4	.25	.036	.001	.08	.05	.04			
	Third Selection Level										
	Type of Instructors										
	Classroom Teachers	5	.01	.060	.004	.08	.08	.09	.09	-	
	Free-Meals Participation	NS	-.26	NS	NS	-.08	-.04	-.02	.00	.00	
	Special Teachers	NS	-.11	NS	NS	-.06	-.01	-.01	-.01	-.01	
	Aides/Asst/Tutor	NS	-.14	NS	NS	-.06	-.02	-.01	-.00	.00	
	Independent Work	NS	.08	NS	NS	-.00	-.02	-.02	-.02	-.01	
	Multiple R^2(R) for the Reg. Eq.			.550 (.741)							
	Size of Instructional Group										
	14 or more	5	.10	.071	.005	.10	.10	.10	.10	-	
	Free-Meals Participation	NS	-.26	NS	NS	-.08	-.04	-.02	.00	.01	
	Approximately 7-13	NS	-.12	NS	NS	-.03	-.02	-.02	-.02	.02	
	Approximately 1-6	NS	-.04	NS	NS	-.05	-.04	-.04	-.04	-.00	
	Multiple R^2(R) for the Reg. Eq.			.551 (.742)							
	Instructional Settings										
	Regular Instruction	5	.04	.066	.004	.09	.10	.10	.10	-	
	Free-Meals Participation	NS	-.26	NS	NS	-.08	-.04	-.02	.00	.00	
	Special Instruction	NS	-.16	NS	NS	-.09	-.05	-.04	-.04	-.01	
	Tutor/Independent	NS	.07	NS	NS	.00	-.01	-.02	-.01	-.00	
	Multiple R^2(R) for the Reg. Eq.			.550 (.742)							

* The forward stepwise selection procedure always enters the pretest score into the regression equation first. At the second selection level, variables describing student background characteristics are entered sequentially until none of the remaining variables has a partial F-for-inclusion exceeding 2.0. The background variables refer to race/ethnicity (1 = Caucasian/White; 0 = Non-Caucasian/White), participation in free or reduced-price meals (a proxy for economic status, 1 = participation; 0 = non-participation), teacher's judgment of CE need in the subject area (1 = need; 0 = no need), and mother's educational attainment (1 = high school graduate or above; 0 = less than high school). At the third level, *the background variables not yet entered at the second level* and a set of composite variables describing the nature and amount of instructional services received are involved in the selection. Again, these variables are entered into the equation sequentially until the partial F's for all non-entered variables are less than 2.0. Three different sets of service composites were investigated separately. Their constructions are explained in Figure 6-1. (NS = Not Selected.)

Table F-3

The Effects of Instructional Services on Reading and Math Achievement of the Third Graders

	Hierarchical-Stepwise Selection of Predictor Variables for Posttest Achievement Scores*	Entry Order*	Correlation with Posttest	Standard Regression Coefficient	Increase in R^2	Partial Correlation with Posttest Given the Variables of Entry Orders						
						1	1-2	1-3	1-4	1-5	1-6	1-7
Analysis for Reading (N=1,394)	Highest Selection Level											
	Pretest	1	.84	.715	.707	-						
	Second Selection Level											
	Judged Need in CE	2	-.60	-.100	.010	-.19	-					
	Mother's Educ. Attainment	3	.36	.060	.004	.14	.13	-				
	White/Minority Status	4	.37	.045	.003	.12	.10	.10	-			
	Free-Meals Participation	5	-.39	-.041	.001	-.13	-.12	-.09	-.06	-		
	Third Selection Level											
	Type of Instructors											
	Special Teachers	6	-.34	-.033	.001	-.10	-.04	-.05	-.05	-.05	-	
	Classroom Teachers	NS	.01	NS	NS	-.04	-.04	-.03	-.03	-.03	-.04	
	Aides/Asst/Tutor	NS	-.24	NS	NS	-.06	-.01	-.00	-.00	.00	-.00	
	Independent Work	NS	.13	NS	NS	.02	.01	.00	.01	.01	.00	
	Multiple R^2(R) for the Reg. Eq.			.727 (.852)								
	Size of Instructional Group											
	Approximately 7-13	6	-.06	-.026	.001	-.08	-.06	-.05	-.05	-.05	-	
	14 or more	NS	.06	NS	NS	.03	.01	.01	.01	.02	.00	
	Approximately 1-6	NS	-.10	NS	NS	-.03	-.00	-.01	-.01	-.02	-.03	
	Multiple R^2(R) for the Reg. Eq.			.726 (.852)								
	Instructional Settings											
	Special Instruction	6	-.33	-.036	.001	-.09	-.03	-.04	-.04	-.04	-	
	Regular Instruction	7	.07	-.023	<.001	-.02	-.03	-.02	-.02	-.02	-.04	-
	Tutor/Independent	NS	.11	NS	NS	.02	.01	.00	.01	.01	.01	.00
	Multiple R^2(R) for the Reg. Eq.			.727 (.853)								
Analysis for Math (N=1,160)	Highest Selection Level											
	Pretest	1	.73	.613	.538	-						
	Second Selection Level											
	Judged Need in CE	2	-.51	-.166	.027	-.24	-					
	White/Minority Status	3	.31	.068	.007	.17	.12	-				
	Free-Meals Participation	4	-.32	-.060	.003	-.15	-.12	-.08	-			
	Third Selection Level											
	Type of Instructors											
	Independent Work	5	.12	.062	.001	.08	.07	.06	.06	-		
	Classroom Teachers	6	.01	.052	.002	.03	.02	.04	.04	.07	-	
	Special Teachers	7	-.13	.033	.001	-.04	.03	.04	.04	.05	.05	-
	(Mother's Educ. Attainment)	NS	.24	NS	NS	.10	.06	.05	.03	.03	.03	.03
	Aides/Asst/Tutor	NS	-.17	NS	NS	-.07	-.02	-.02	-.01	-.01	.00	.00
	Multiple R^2(R) for the Reg. Eq.			.579 (.761)								
	Size of Instructional Group											
	14 or more	5	.08	.079	.002	.09	.07	.07	.08	-		
	Approximately 1-6	6	-.01	.055	.002	.01	.03	.02	.02	.07	-	
	(Mother's Educ. Attainment)	NS	.24	NS	NS	.10	.06	.05	.03	.03	.03	
	Approximately 7-13	NS	-.07	NS	NS	-.07	-.04	-.02	-.02	.01	.04	
	Multiple R^2(R) for the Reg. Eq.			.579 (.761)								
	Instructional Settings											
	Regular Instruction	5	.06	.067	.002	.05	.05	.06	.06	-		
	Tutor/Independent	6	.12	.063	.003	.07	.06	.05	.05	.09	-	
	(Mother's Educ. Attainment)	NS	.24	NS	NS	.10	.06	.05	.03	.03	.03	
	Special Instruction	NS	-.20	NS	NS	-.09	-.03	-.02	-.02	.01	.02	
	Multiple R^2(R) for the Reg. Eq.			.579 (.761)								

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* The forward stepwise selection procedure always enters the pretest score into the regression equation first. At the second selection level, variables describing student background characteristics are entered sequentially until none of the remaining variables has a partial F-for-inclusion exceeding 2.0. The background variables refer to race/ethnicity (1 = Caucasian/White; 0 = Non-Caucasian/White), participation in free or reduced-price meals (a proxy for economic status, 1 = participation; 0 = non-participation), teacher's judgment of CE need in the subject area (1 = need; 0 = no need), and mother's educational attainment (1 = high school graduate or above; 0 = less than high school). At the third level, *the background variables not yet entered at the second level* and a set of composite variables describing the nature and amount of instructional services received are involved in the selection. Again, these variables are entered into the equation sequentially until the partial F's for all non-entered variables are less than 2.0. Three different sets of service composites were investigated separately. Their constructions are explained in Figure 6-1. (NS = Not Selected.)

Table F-4

The Effects of Instructional Services on Reading and Math Achievement of the Fourth Graders

	Hierarchical-Stepwise Selection of Predictor Variables for Posttest Achievement Scores*	Entry Order*	Correlation with Posttest	Standard Regression Coefficient	Increase in R^2	Partial Correlation with Posttest Given the Variables of Entry Orders							
						1	1-2	1-3	1-4	1-5	1-6	1-7	1-8
Analysis for Reading (N=1,338)	Highest Selection Level												
	Pretest	1	.88	.810	.769	-							
	Second Selection Level												
	Judged Need in CE	2	-.58	-.079	.005	-.14	-						
	Mother's Educ. Attainment	3	.33	.037	.001	.09	.07	-					
	White/Minority Status	4	.32	.024	<.001	.06	.05	.05	-				
	Third Selection Level												
	Type of Instructors												
	(Free-Meals Participation)	NS	-.36	NS	NS	-.06	-.05	-.03	-.02				
	Classroom Teachers	NS	.01	NS	NS	-.00	-.00	.00	.01				
	Special Teachers	NS	-.35	NS	NS	-.05	-.01	-.00	-.01				
	Aides/Asst/Tutor	NS	-.20	NS	NS	.00	.02	.03	.03				
	Independent Work	NS	.04	NS	NS	-.01	-.01	-.01	-.01				
	Multiple R^2(R) for the Reg. Eq.			.776 (.881)									
	Size of Instructional Group												
	(Free-Meals Participation)	NS	-.36	NS	NS	-.06	-.05	-.03	-.02				
	14 or more	NS	.10	NS	NS	.03	.03	.03	.03				
	Approximately 7-13	NS	-.10	NS	NS	-.04	-.03	-.02	-.02				
	Approximately 1-6	NS	-.19	NS	NS	-.03	-.01	-.01	-.01				
	Multiple R^2(R) for the Reg. Eq.			.776 (.881)									
	Instructional Settings												
	(Free-Meals Participation)	NS	-.36	NS	NS	-.06	-.05	-.03	-.02				
	Regular Instruction	NS	.08	NS	NS	.02	.02	.02	.02				
	Special Instruction	NS	-.37	NS	NS	-.07	-.03	-.03	-.03				
	Tutor/Independent	NS	.04	NS	NS	-.00	-.01	-.01	-.01				
	Multiple R^2(R) for the Reg. Eq.			.776 (.881)									
Analysis for Math (N=1,287)	Highest Selection Level												
	Pretest	1	.77	.698	.593	-							
	Second Selection Level												
	Free-Meals Participation	2	-.31	-.064	.008	-.14	-						
	Judged Need in CE	3	-.45	-.090	.004	-.12	-.10	-					
	Mother's Educ. Attainment	4	.28	.054	.002	.12	.08	.07	-				
	Third Selection Level												
	Type of Instructors												
	Special Teachers	5	-.11	.073	.003	.04	.05	.08	.08	-			
	Classroom Teachers	6	-.01	.068	.002	.03	.05	.05	.05	.06	-		
	(White/Minority Status)	7	.25	.028	.001	.08	.04	.03	.03	.03	.04	-	
	Independent Work	8	.04	.042	.001	.00	-.00	.00	-.00	.01	.06	.06	-
	Aides/Asst/Tutor	NS	-.17	NS	NS	-.04	-.04	-.03	-.02	-.02	-.01	-.01	-.01
	Multiple R^2(R) for the Reg. Eq.			.613 (.783)									
	Size of Instructional Group												
	14 or more	5	.06	.083	.001	.04	.05	.04	.04	-			
	Approximately 7-13	6	-.08	.059	.001	.00	.02	.03	.03	.06	-		
	Approximately 1-6	7	-.08	.053	.001	-.01	-.01	.00	.00	.04	.06	-	
	(White/Minority Status)	8	.25	.030	.001	.08	.04	.03	.03	.03	.04	.04	
	Multiple R^2(R) for the Reg. Eq.			.611 (.782)									
	Instructional Settings												
	Special Instruction	5	-.18	.065	.001	.02	.03	.06	.06	-			
	Regular Instruction	6	.03	.056	.002	.03	.04	.04	.04	.07	-		
	(White/Minority Status)	7	.25	.032	.001	.08	.04	.03	.03	.04	.05	-	
	Tutor/Independent	NS	.03	NS	NS	-.01	-.01	-.01	-.01	-.01	.04	.04	
	Multiple R^2(R) for the Reg. Eq.			.611 (.782)									

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*The forward stepwise selection procedure always enters the pretest score into the regression equation first. At the second selection level, variables describing student background characteristics are entered sequentially until none of the remaining variables has a partial F-for inclusion exceeding 2.0. The background variables refer to race/ethnicity (1 = Caucasian/White; 0 = Non-Caucasian/White), participation in free or reduced-price meals (a proxy for economic status, 1 = participation; 0 = non-participation), teacher's judgment of CE need in the subject area (1 = need; 0 = no need), and mother's educational attainment (1 = high school graduate or above; 0 = less than high school). At the third level, *the background variables not yet entered at the second level* and a set of composite variables describing the nature and amount of instructional services received are involved in the selection. Again, these variables are entered into the equation sequentially until the partial F's for all non-entered variables are less than 2.0. Three different sets of service composites were investigated separately. Their constructions are explained in Figure 6-1. (NS = Not Selected.)

Table F-5

The Effects of Instructional Services on Reading and Math Achievement of the Fifth Graders

	Hierarchical-Stepwise Selection of Predictor Variables for Posttest Achievement Scores*	Entry Order*	Correlation with Posttest	Standard Regression Coefficient	Increase in R^2	Partial Correlation with Posttest Given the Variables of Entry Orders					
						1	1-2	1-3	1-4	1-5	1-6
Analysis for Reading (N=1,433)	Highest Selection Level										
	Pretest	1	.89	.825	.800	-					
	Second Selection Level										
	Free-Meals Participation	2	.47	-.084	.007	-.19	-				
	Judged Need in CE	3	-.56	-.044	.001	-.11	-.09	-			
	Mother's Educ. Attainment	4	.35	.019	<.001	.09	.05	.04	-		
	Third Selection Level										
	Type of Instructors										
	Independent Work	5	.05	.017	<.001	.04	.04	.04	.04	-	
	(White/Minority Status)	NS	.40	NS	NS	.10	.03	.03	.03	.03	
	Classroom Teachers	NS	-.05	NS	NS	-.03	-.01	-.01	-.01	.00	
	Special Teachers	NS	-.29	NS	NS	-.04	-.04	-.02	-.02	-.02	
	Aides/Asst/Tutor	NS	-.16	NS	NS	-.02	.00	.02	.02	.02	
	Multiple R^2(R) for the Reg. Eq.			.809 (.899)							
	Size of Instructional Group										
	(White/Minority Status)	NS	.40	NS	NS	.10	.03	.03	.03		
	14 or more	NS	.06	NS	NS	.00	.02	.01	.01		
	Approximately 7-13	NS	-.15	NS	NS	-.03	.02	-.01	-.01		
	Approximately 1-6	NS	-.12	NS	NS	.00	.01	.02	.01		
	Multiple R^2(R) for the Reg. Eq.			.809 (.899)							
	Instructional Settings										
	Tutor/Independent	5	.05	.018	<.001	.04	.04	.04	.04	-	
	(White/Minority Status)	NS	.40	NS	NS	.10	.03	.03	.03	.03	
	Regular Instruction	NS	-.00	NS	NS	-.01	.01	.00	.00	.02	
	Special Instruction	NS	-.27	NS	NS	-.05	-.04	-.02	-.02	-.02	
	Multiple R^2(R) for the Reg. Eq.			.809 (.899)							
Analysis for Math (N=1,375)	Highest Selection Level										
	Pretest	1	.81	.750	.655	-					
	Second Selection Level										
	Free-Meals Participation	2	-.38	-.047	.005	-.12	-				
	Judged Need in CE	3	-.47	-.052	.002	-.11	-.08	-			
	White/Minority Status	4	.33	.046	.001	.11	.06	.06	-		
	Third Selection Level										
	Type of Instructors										
	Classroom Teachers	5	.00	.032	.001	.05	.05	.05	.05	-	
	(Mother's Educ. Attainment)	NS	.28	NS	NS	.07	.04	.03	.04	.03	
	Special Teachers	NS	-.11	NS	NS	-.02	-.01	.00	.00	.01	
	Aides/Asst/Tutor	NS	-.14	NS	NS	-.03	-.02	-.01	-.00	.01	
	Independent Work	NS	.02	NS	NS	-.01	-.01	-.01	-.01	.03	
	Multiple R^2(R) for the Reg. Eq.			.665 (.815)							
	Size of Instructional Group										
	14 or more	5	.11	.082	.003	.10	.10	.10	.10	-	
	Approximately 1-6	6	-.12	.038	.001	-.04	-.04	-.04	-.03	.05	-
	(Mother's Educ. Attainment)	NS	.28	NS	NS	.07	.04	.03	.04	.03	.03
	Approximately 7-13	NS	-.11	NS	NS	-.07	-.06	-.06	-.06	-.02	.00
	Multiple R^2(R) for the Reg. Eq.			.668 (.817)							
	Instructional Settings										
	Regular Instruction	5	.06	.037	.001	.06	.06	.06	.06	-	
	(Mother's Educ. Attainment)	NS	.28	NS	NS	.07	.04	.03	.04	.03	
	Special Instruction	NS	-.19	NS	NS	-.05	-.04	-.03	-.02	.01	
	Tutor/Independent	NS	.02	NS	NS	-.01	-.01	-.01	-.01	.03	
	Multiple R^2(R) for the Reg. Eq.			.665 (.816)							

* The forward stepwise selection procedure always enters the pretest score into the regression equation first. At the second selection level, variables describing student background characteristics are entered sequentially until none of the remaining variables has a partial F-for-inclusion exceeding 2.0. The background variables refer to race/ethnicity (1 = Caucasian/White; 0 = Non-Caucasian/White), participation in free or reduced-price meals (a proxy for economic status, 1 = participation; 0 = non-participation), teacher's judgment of CE need in the subject area (1 = need; 0 = no need), and mother's educational attainment (1 = high school graduate or above; 0 = less than high school). At the third level, *the background variables not yet entered at the second level* and a set of composite variables describing the nature and amount of instructional services received are involved in the selection. Again, these variables are entered into the equation sequentially until the partial F's for all non-entered variables are less than 2.0. Three different sets of service composites were investigated separately. Their constructions are explained in Figure 6-1. (NS = Not Selected.)

Table F-6

The Effects of Instructional Services on Reading and Math Achievement of the Sixth Graders

	Hierarchical-Stepwise Selection of Predictor Variables for Posttest Achievement Scores*	Entry Order*	Correlation with Posttest	Standard Regression Coefficient	Increase in R^2	Partial Correlation with Posttest Given the Variables of Entry Orders					
						1	1-2	1-3	1-4	1-5	1-6
Analysis for Reading (N=1,596)	Highest Selection Level										
	Pretest	1	.90	.825	.809	-					
	Second Selection Level										
	Judged Need in CE	2	-.58	-.067	.004	-.15	-				
	Mother's Educ. Attainment	3	.36	.043	.002	.11	.10	-			
	White/Minority Status	4	.37	.041	.001	.09	.09	.08	-		
	Third Selection Level										
	Type of Instructors										
	Independent Work	5	.02	.022	.001	.06	.04	.04	.05	-	
	Special Teachers	6	-.31	-.017	<.001	-.08	-.04	-.04	-.04	-.04	-
	(Free-Meals Participation)	NS	-.38	NS	NS	-.07	-.06	-.04	-.01	-.02	-.01
	Classroom Teachers	NS	.02	NS	NS	.00	.01	.00	.01	.03	.02
	Aides/Asst/Tutor	NS	-.22	NS	NS	-.02	.00	.01	.02	.02	.02
	Multiple R^2(R) for the Reg. Eq.			.817 (.904)							
	Size of Instructional Group										
	(Free-Meals Participation)	NS	-.38	NS	NS	-.07	-.06	-.04	-.01		
	14 or more	NS	.13	NS	NS	.01	.00	-.00	-.00		
	Approximately 7-13	NS	-.18	NS	NS	-.01	.00	.00	.01		
	Approximately 1-6	NS	-.16	NS	NS	.01	.02	.02	.03		
	Multiple R^2(R) for the Reg. Eq.			.816 (.903)							
	Instructional Settings										
	Tutor/Independent	5	.01	.025	.001	.06	.04	.04	.06	-	
	(Free-Meals Participation)	NS	-.38	NS	NS	-.07	-.06	-.04	-.01	-.02	
	Regular Instruction	NS	.07	NS	NS	.01	.01	.01	.01	.03	
	Special Instruction	NS	-.33	NS	NS	-.07	-.04	-.04	-.03	-.03	
	Multiple R^2(R) for the Reg. Eq.			.817 (.904)							
Analysis for Math (N=1,553)	Highest Selection Level										
	Pretest	1	.82	.755	.679	-					
	Second Selection Level										
	Mother's Educ. Attainment	2	.29	.059	.005	.12	-				
	Judged Need in CE	3	-.48	-.071	.004	-.12	-.11	-			
	Free-Meals Participation	4	-.31	-.029	.001	-.10	-.07	-.07	-		
	White/Minority Status	5	.27	.027	.001	.08	.07	.07	.04	-	
	Third Selection Level										
	Type of Instructors										
	Classroom Teachers	NS	.04	NS	NS	.00	.00	.01	.01	.01	
	Special Teachers	NS	-.16	NS	NS	-.05	-.05	-.03	-.03	-.02	
	Aides/Asst/Tutor	NS	-.17	NS	NS	-.01	-.00	.01	.02	.02	
	Independent Work	NS	.04	NS	NS	.02	.02	.01	.01	.01	
	Multiple R^2(R) for the Reg. Eq.			.690 (.831)							
	Size of Instructional Group										
	14 or more	NS	.11	NS	NS	-.00	-.01	-.01	-.01	-.01	
	Approximately 7-13	NS	-.08	NS	NS	.01	.00	.02	.02	.03	
	Approximately 1-6	NS	-.09	NS	NS	-.01	-.00	.00	.01	.01	
	Multiple R^2(R) for the Reg. Eq.			.690 (831)							
	Instructional Settings										
	Regular Instruction	NS	.08	NS	NS	.01	.01	.01	.01	.01	
	Special Instruction	NS	-.21	NS	NS	-.05	-.04	-.02	-.02	-.01	
	Tutor/Independent	NS	.03	NS	NS	.02	.02	.01	.01	.02	
	Multiple R^2(R) for the Reg. Eq.			.690 (.831)							

* The forward stepwise selection procedure always enters the pretest score into the regression equation first. At the second selection level, variables describing student background characteristics are entered sequentially until none of the remaining variables has a partial F-for-inclusion exceeding 2.0. The background variables refer to race/ethnicity (1 = Caucasian/White; 0 = Non-Caucasian/White), participation in free or reduced-price meals (a proxy for economic status, 1 = participation; 0 = non-participation), teacher's judgment of CE need in the subject area (1= need; 0 = no need), and mother's educational attainment (1 = high school graduate or above; 0 = less than high school). At the third level, *the background variables not yet entered at the second level* and a set of composite variables describing the nature and amount of instructional services received are involved in the selection. Again, these variables are entered into the equation sequentially until the partial F's for all non-entered variables are less than 2.0. Three different sets of service composites were investigated separately. Their constructions are explained in Figure 6-1. (NS = Not Selected.)

Table F-7

Correlations of Student-Background Variables and Education-Process Variables with Posttest Achievement Scores
(Based on 15% Random Samples from Each Grade from the First-Year SES Data Base)

Background Variables and Variables Describing the Educational Processes*	Reading Achievement Posttest						Math Achievement Posttest					
Grade	1	2	3	4	5	6	1	2	3	4	5	6
N =	1,478	1,390	1,394	1,338	1,433	1,596	1,430	1,375	1,360	1,287	1,375	1,553
Background Variables												
Pretest VSS Score	.66	.80	.84	.88	.89	.90	.67	.72	.73	.77	.81	.82
White/Minority Status	.21	.29	.37	.32	.40	.37	.21	.25	.31	.25	.33	.27
Free-Meals Participation	-.33	-.36	-.39	-.36	-.47	-.38	-.28	-.2[illegible]	-.32	-.31	-.38	-.31
Teacher's Judgment of CE Need	-.49	-.56	-.60	-.58	-.56	-.58	-.41	-.43	-.51	-.45	-.47	-.48
Mother's Educational Attainment	.31	.32	.36	.33	.35	.36	.27	.24	.24	.28	.28	.29
Characteristics of Instructional Personnel												
Staff/Student Ratio	-.05	-.09	-.03	-.09	-.05	-.04	-.00	-.03	.00	-.06	-.03	-.04
Support/Teaching Personnel Ratio	.00	-.02	-.01	-.06	-.04	-.00	-.03	.01	-.01	.01	-.01	-.02
Years of Teaching	.12	.12	.08	.15	.08	.07	.07	.14	.08	.15	.05	.10
Highest Degree Earned	-.03	-.05	-.07	-.03	-.04	-.04	-.05	-.03	-.04	-.08	.00	.02
Recent Inservice Training	-.01	-.11	-.11	-.19	-.07	-.09	-.03	-.02	-.06	.01	.00	.01
Belief in Schooling	-.03	-.07	-.07	-.04	-.02	.02	.01	-.04	.01	-.02	-.03	-.05
Attitude to School Programs	.10	.06	.10	.04	.10	.19	.10	.06	.09	-.01	.11	.13
Characteristics of Educational Environment												
School's Minority Concentration	-.18	-.28	-.37	-.25	-.35	-.35	-.19	-.23	-.34	-.21	-.31	-.26
School's Poverty Concentration	-.27	-.33	-.43	-.34	-.40	-.38	-.26	-.27	-.39	-.29	-.35	-.29
School's CE Concentration	-.13	-.2[illegible]	-.27	-.20	-.15	-.23	-.10	-.15	-.19	-.19	-.10	-.13
School's Low-Achiever Concentration	-.35	-.39	-.51	-.40	-.47	-.44	-.32	-.34	-.48	-.35	-.44	-.36
School's Central Resources	.06	.01	.07	-.02	-.02	-.00	.02	-.04	.01	-.03	-.02	-.05
Student Mobility Rate	-.08	-.04	-.13	-.06	-.09	-.06	-.06	-.07	-.12	-.07	-.11	-.09
Parent/Community Involvement	-.11	-.12	-.15	-.09	-.02	-.10	-.11	-.09	-.16	-.10	-.03	-.11
District Control of Instruction	.00	-.07	.01	-.06	-.07	-.05	-.01	-.05	.00	-.04	-.07	-.02
Principal's Instructional Leadership	.07	-.05	-.04	-.05	-.00	-.05	-.01	-.01	-.07	-.08	.00	-.05
Teacher's Involvement in Decisions	.02	-.03	-.03	-.03	.02	.03	.01	-.03	-.03	-.09	.01	.04
Disturbance of Instruction	-.08	-.12	-.21	-.13	-.22	-.18	-.11	-.11	-.19	-.13	-.22	-.16
District's Testing Program	-.00	-.04	-.02	.00	-.01	-.05	-.01	-.03	-.04	-.01	.04	-.00
District's Percent of Administrative Staff	-.06	-.05	-.01	-.02	-.05	-.06	-.05	-.00	-.00	-.03	-.07	-.07
Characteristics of Educational Practices												
Effort in Curriculum Development	.00	-.06	-.07	-.10	-.07	-.12	-.02	.00	-.05	-.08	-.09	.05
Effort in Planning and Evaluation	.09	-.03	.03	-.04	-.01	-.11	.02	-.02	.03	.02	-.08	.01
Teacher's Use of Lesson Plans	.09	.04	.12	.06	-.01	.04	-.03	-.01	.09	.04	.06	-.03
Frequency of Feedback per Semester	.06	.07	-.01	-.05	.01	-.07	.07	.08	.05	.06	.02	.04
Weekly Homework Assigned	-.02	.03	-.06	.00	.01	.08	-.02	-.03	-.05	.08	.00	.14
Monthly Use of Materials	.06	.06	.10	.05	-.01	-.07	-.01	.09	.05	-.09	-.08	-.02
Individualization of Instruction	-.07	-.06	-.17	-.11	-.20	-.14	-.07	-.06	-.13	-.11	-.12	-.04
Monthly Use of Audio-Visual Equipment	.01	-.07	-.17	-.18	-.20	-.21	-.08	-.03	-.02	-.08	-.06	-.08
Characteristics of Classroom Organization												
Classroom Achievement Level	-.01	.02	-.04	-.01	.01	-.06	-.02	.04	-.06	-.02	-.01	-.05
Extent of Ability Grouping	-.02	.01	.00	-.04	-.04	.01	-.00	.01	-.01	-.04	-.02	-.01
Class Size	-.01	.05	.07	.14	.11	.15	.02	.02	.05	.06	.01	.08

[*] When applicable, process variables specific to reading instruction are correlated with reading posttest scores and those specific to math instruction with math posttest scores. Some variables have been aggregated to school levels. The following categorical variables have been specifically coded for the correlational analyses: Teacher Judgment of CE Need (0 = No Need of CE in subject area, 1 = Need CE in subject area); School's Central Resources (0 = no resource center in subject area, 1 = presence of resource center in subject area); Teacher's Use of Lesson Plans (0 = lesson plans in subject area are not used, 1 = lesson plans in subject area are used); Classroom Achievement Level (0 = homogeneous achievement level in subject area, 1 = heterogeneous achievement levels in subject area).

Table F-8

Effects of Characteristics of Instructional Personnel on Student Achievement, Adjusted for Differences in Student Background Characteristics (Based on 15% Random Samples from Each Grade from the First-Year SES Data Base)

	Selected Student Background Variables and Characteristics of Instructional Personnel for the Prediction of Achievement Posttest Score*	Regression Model for Predicting Reading Posttest Score				Regression Model for Predicting Math Posttest Score			
		Entry Order*	Standardized Regression Coefficient	Increment in R^2 in Sequence	Tolerance	Entry Order*	Standardized Regression Coefficient	Increment in R^2 in Sequence	Tolerance
GRADE 1	Pretest Score	1	.523	.438		1	.582	.445	
	Free-Meals Participation	4	-.040	.001	.783	3	-.055	.004	.875
	Teacher's Judgment of CE Need	2	-.205	.038	.774	2	-.150	.023	.830
	Mother's Educational Attainment	3	.070	.005	.871	4	.036	.001	.826
	Support/Teaching Personnel Ratio	7	.033	<.001	.992	NA			
	Years of Teaching	5	.064	<.001	.992	5	.038	.002	.993
	Recent Inservice Training	6	.051	<.001	.976	7	.040	.002	.977
	Belief in Schooling	NA				6	.041	.002	.996
	Attitude to School Programs	8	.028	<.001	.979	NA			
	R^2 (R) for the Regression Model		.490 (.700)				.478 (.691)		
GRADE 2	Pretest Score	1	.660	.636		1	.642	.525	
	White/Minority Status	4	.068	.004	.776	4	.021	.001	.888
	Free-Meals Participation	3	-.061	.011	.893	NA			
	Teacher's Judgment of CE Need	2	-.149	.018	.680	2	-.132	.016	.811
	Mother's Educational Attainment	5	.050	.002	.823	3	.060	.004	.926
	Years of Teaching	6	.042	.001	.977	5	.094	.009	.982
	Belief in Schooling	8	-.024	.001	.990	NA			
	Attitude to School Programs	7	-.027	.001	.943	NA			
	R^2 (R) for the Regression Model		.673 (.821)				.555 (.745)		
GRADE 3	Pretest Score	1	.715	.707		1	.612	.538	
	White/Minority Status	4	.040	.003	.857	3	.058	.007	.877
	Free-Meals Participation	5	-.046	.001	.702	4	-.066	.003	.775
	Teacher's Judgment of CE Need	2	-.118	.010	.610	2	-.167	.027	.750
	Mother's Educational Attainment	3	.057	.004	.875	NA			
	Staff/Student Ratio	8	.028	.001	.955	7	.031	.001	.961
	Years of Teaching	6	.031	.001	.992	6	.037	.001	.986
	Highest Degree Earned	9	.024	.001	.957	NA			
	Recent Inservice Training	7	-.029	.001	.977	5	-.045	.002	.988
	R^2 (R) for the Regression Model		.729 (.854)				.578 (.761)		
GRADE 4	Pretest Score	1	.806	.769		1	.694	.593	
	White/Minority Status	4	.024	<.001	.886	NA			
	Free-Meals Participation	NA				2	-.066	.008	.915
	Teacher's Judgment of CE Need	2	-.078	.005	.644	3	-.075	.004	.734
	Mother's Educational Attainment	3	.037	.001	.876	4	.051	.002	.844
	Years of Teaching	5	.033	.001	.981	5	.043	.002	.978
	Recent Inservice Training	NA				6	.031	.001	.993
	R^2 (R) for the Regression Model		.777 (.881)				.610 (.781)		
GRADE 5	Pretest Score	1	.822	.800		1	.747	.655	
	White/Minority Status	NA				4	.039	.001	.715
	Free-Meals Participation	2	-.083	.007	.809	2	-.036	.005	.850
	Teacher's Judgment of CE Need	3	-.046	.001	.651	3	-.053	.002	.704
	Mother's Educational Attainment	4	.022	<.001	.833	6	.026	<.001	.852
	Support/Teaching Personnel Ratio	NA				8	.026	.001	.974
	Years of Teaching	5	.029	.001	.992	9	.025	.001	.914
	Highest Degree Earned	NA				7	.031	.001	.988
	Attitude to School Programs	NA				5	.033	.001	.967
	R^2 (R) for the Regression Model		.810 (.900)				.668 (.817)		
GRADE 6	Pretest Score	1	.826	.809		1	.753	.679	
	White/Minority Status	4	.046	.001	.860	5	.029	.001	.742
	Free-Meals Participation	NA				4	-.020	.001	.833
	Teacher's Judgment of CE Need	2	-.080	.004	.663	3	-.075	.004	.733
	Mother's Educational Attainment	3	.040	.002	.868	2	.055	.005	.924
	Support/Teaching Personnel Ratio	7	-.018	<.001	.981	6	-.045	.001	.985
	Years of Teaching	NA				7	.043	.001	.948
	Recent Inservice Training	5	.031	.001	.952	NA			
	Belief in Schooling	6	.021	<.001	.992	8	-.040	.002	.975
	R^2 (R) for the Regression Model		.818 (.904)				.694 (.833)		

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*Variables describing student's background and characteristics of instructional personnel that were employed as potential predictors are given in Table F-7. A criterion of 2.0 for the 'partial F-to-enter' was used for the selection of the prediction model presented here. In the forward stepwise selection procedure, background variables (the first listed) were given a higher priority of entry over the characteristics of instructional personnel, so that the background differences were adjusted in the assessment of the effects of the characteristics of instructional personnel. The 'Tolerance' column reports the proportion of variance of the predictor not explained by other predictors already entered into the regression model, so values near 1.0 indicate lack of collinearity among the predictors. (NA = Not Applicable.)

Table F-9

Effects of Characteristics of the Educational Environment on Student Achievement, Adjusted for Differences in Student Background Characteristics (Based on 15% Random Samples from Each Grade from the First-Year SES Data Base)

	Selected Student Background Variables and Characteristics of Educational Environment for the Prediction of Achievement Posttest Score*	Regression Model for Predicting Reading Posttest Score				Regression Model for Predicting Math Posttest Score			
		Entry Order*	Standardized Regression Coefficient	Increment in R^2 in Sequence	Tolerance	Entry Order*	Standardized Regression Coefficient	Increment in R^2 in Sequence	Tolerance
GRADE 1	Pretest Score	1	.524	.438		1	.564	.445	
	Free-Meals Participation	4	-.063	.001	.783	3	-.051	.004	.875
	Teacher's Judgment of CE Need	2	-.218	.038	.774	2	-.147	.023	.830
	Mother's Educational Attainment	3	.068	.005	.871	4	.034	.001	.826
	School's Minority Concentration	NA				7	.048	.001	.435
	School's CE Concentration	5	.065	.004	.851	NA			
	School's Low-Achiever Concentration	NA				6	-.077	.002	.703
	School's Central Resources	9	.039	.001	.900	5	.034	.002	.982
	Parent/Community Involvement	6	-.092	.003	.896	NA			
	District Control of Instruction	10	.029	.001	.965	NA			
	Principal's Instructional Leadership	7	.056	.005	.898	NA			
	Disturbance of Instruction	8	.059	.002	.834	NA			
	R^2 (R) for the Regression Model		.498(.705)				.477(.691)		
GRADE 2	Pretest Score	1	.653	.636		1	.637	.525	
	White/Minority Status	4	.048	.004	.776	4	.056	.001	.888
	Free-Meals Participation	3	-.055	.011	.893	NA			
	Teacher's Judgment of CE Need	2	-.151	.018	.680	2	-.125	.016	.811
	Mother's Educational Attainment	5	.048	.002	.823	3	.054	.004	.926
	School's Minority Concentration	NA				8	.080	.002	.268
	School's CE Concentration	10	.027	.001	.726	NA			
	School's Low-Achiever Concentration	6	-.053	.001	.582	7	-.094	.002	.596
	Parent/Community Involvement	NA				6	.053	.002	.861
	District Control of Instruction	7	-.028	.001	.973	NA			
	Teachers' Involvement in Decisions	9	-.029	.001	.981	5	-.051	.002	.993
	District's % of Administrative Staff	8	-.028	.001	.969	NA			
	R^2 (R) for the Regression Model		.674(.821)				.553(.744)		
GRADE 3	Pretest Score	1	.699	.707		1	.588	.538	
	White/Minority Status	4	-.003	.003	.857	3	.010	.007	.877
	Free-Meals Participation	5	-.022	.001	.702	4	-.006	.003	.775
	Teacher's Judgment of CE Need	2	-.108	.010	.610	2	-.135	.027	.750
	Mother's Educational Attainment	3	.054	.004	.875	NA			
	School's Minority Concentration	NA				7	.087	.002	.284
	School's Low-Achiever Concentration	6	-.103	.005	.530	5	-.275	.031	.592
	Parent/Community Involvement	NA				8	-.031	.001	.906
	Principal's Instructional Leadership	8	-.028	.001	.962	NA			
	District's Testing Program	NA				9	-.025	.001	.949
	District's % of Administrative Staff	7	.037	.002	.986	6	.052	.003	.975
	R^2 (R) for the Regression Model		.733(.856)				.612(.782)		
GRADE 4	Pretest Score	1	.816	.769		1	.683	.593	
	White/Minority Status	4	.063	<.001	.886	NA			
	Free-Meals Participation	NA				2	-.046	.008	.915
	Teacher's Judgment of CE Need	2	-.076	.005	.644	3	-.068	.004	.734
	Mother's Educational Attainment	3	.034	.001	.876	4	.041	.002	.844
	School's Minority Concentration	5	.054	.001	.444	7	.069	.002	.474
	School's CE Concentration	NA				8	-.036	.002	.876
	School's Low-Achiever Concentration	NA				5	-.102	.004	.756
	Parent/Community Involvement	NA				9	-.030	.001	.799
	Principal's Instructional Leadership	NA				6	-.032	.002	.987
	R^2 (R) for the Regression Model		.777(.882)				.616(.785)		
GRADE 5	Pretest Score	1	.810	.800		1	.717	.655	
	White/Minority Status	NA				4	.025	.001	.715
	Free-Meals Participation	2	-.070	.007	.809	2	-.042	.005	.850
	Teacher's Judgment of CE Need	3	-.048	.001	.651	3	-.060	.002	.704
	Mother's Educational Attainment	4	.020	<.001	.833	6	.022	.001	.853
	School's Poverty Concentration	NA				8	.058	.002	.288
	School's Low-Achiever Concentration	7	-.032	.001	.604	5	-.103	.004	.586
	Parent/Community Involvement	6	.027	.001	.962	9	.042	.001	.906
	Teachers' Involvement in Decisions	NA				10	-.031	.001	.921
	Disturbance of Instruction	5	-.028	.001	.935	7	-.054	.002	.864
	R^2 (R) for the Regression Model		.811(.900)				.674(.821)		
GRADE 6	Pretest Score	1	.819	.809		1	.756	.679	
	White/Minority Status	4	.039	.001	.860	5	.040	.001	.742
	Free-Meals Participation	NA				4	-.042	.001	.833
	Teacher's Judgment of CE Need	2	-.075	.004	.663	3	-.074	.004	.733
	Mother's Educational Attainment	3	.038	.002	.868	2	.060	.005	.924
	School's Minority Concentration	6	.038	<.001	.235	NA			
	School's Poverty Concentration	NA				6	.044	.001	.493
	School's Low-Achiever Concentration	5	-.052	<.001	.543	NA			
	Disturbance of Instruction	NA				7	-.025	.001	.847
	District's % of Administrative Staff	7	.016	<.001	.970	NA			
	R^2 (R) for the Regression Model		.817(.904)				.691(.831)		

*Variables describing student's background and characteristics of educational environment that were employed as potential predictors are given in Table F-7. A criterion of 2.0 for the 'partial F-to-enter' was used for the selection of the prediction model presented here. In the forward stepwise selection procedure, background variables (the first listed) were given a higher priority of entry over the characteristics of educational environment, so that the background differences were adjusted in the assessment of the effects of the characteristics of educational environment. The 'Tolerance' column reports the proportion of variance of the predictor not explained by other predictors already entered into the regression model, so values near 1.0 indicate lack of collinearity among the predictors. (NA = Not Applicable.)

Table F-10

Effects of Characteristics of Educational Practices on Student Achievement, Adjusted for Differences in Student Background Characteristics (Based on 15% Random Samples from Each Grade from the First-Year SES Data Base)

	Selected Student Background Variables and Characteristics of Educational Practices for the Prediction of Achievement Posttest Score*	Regression Model for Predicting Reading Posttest Score				Regression Model for Predicting Math Posttest Score			
		Entry Order*	Standardized Regression Coefficient	Increment in R^2 in Sequence	Tolerance	Entry Order*	Standardized Regression Coefficient	Increment in R^2 in Sequence	Tolerance
GRADE 1	Pretest Score	1	.531	.438		1	.583	.445	
	Free-Meals Participation	4	-.041	.001	.783	3	-.052	.004	.875
	Teacher's Judgment of CE Need	2	-.203	.038	.774	2	-.146	.023	.830
	Mother's Educational Attainment	3	.068	.005	.871	4	.037	.001	.826
	Effort in Curriculum Development	NA				10	-.033	.001	.806
	Effort in Planning and Evaluation	NA				9	.048	.001	.930
	Teacher's Use of Lesson Plans	7	.037	.001	.971	6	-.040	.001	.998
	Frequency of Feedback per Semester	NA				7	.029	.001	.974
	Weekly Homework Assigned	6	.040	.002	.964	5	.049	.002	.974
	Individualization of Instruction	NA				8	-.037	.001	.960
	Monthly Use of Audio-Visual Equipment	5	.055	.003	.993	NA			
	R^2 (R) for the Regression Model		.488 (.698)				.480 (.693)		
GRADE 2	Pretest Score	1	.659	.636		1	.642	.525	
	White/Minority Status	4	.072	.004	.776	4	.035	.001	.888
	Free-Meals Participation	3	-.065	.011	.893	NA			
	Teacher's Judgment of CE Need	2	-.149	.018	.680	2	-.128	.016	.811
	Mother's Educational Attainment	5	.049	.002	.823	3	.063	.004	.926
	Frequency of Feedback per Semester	NA				6	.038	.001	.976
	Weekly Homework Assigned	7	.022	<.001	.968	7	.027	.001	.913
	Monthly Use of Materials	NA				5	.047	.003	.994
	Monthly Use of Audio-Visual Equipment	6	-.025	.001	.990	NA			
	R^2 (R) for the Regression Model		.672 (820)				.551 (.742)		
GRADE 3	Pretest Score	1	.718	.707		1	.615	.538	
	White/Minority Status	4	.043	.003	.857	3	.049	.007	.877
	Free-Meals Participation	5	-.041	.001	.702	4	-.060	.003	.775
	Teacher's Judgment of CE Need	2	-.114	.010	.610	2	-.165	.027	.750
	Mother's Educational Attainment	3	.059	.004	.875	NA			
	Frequency of Feedback per Semester	NA				6	.038	.001	.990
	Weekly Homework Assigned	NA				7	-.045	.002	.961
	Individualization of Instruction	NA				5	-.051	.002	.965
	Monthly Use of Audio-Visual Equipment	NA				8	.029	.001	.923
	R^2 (R) for the Regression Model		.726 (.852)				.580 (.761)		
GRADE 4	Pretest Score	1	.810	.769		1	.698	.593	
	White/Minority Status	4	.024	<.001	.886	6	.020	.001	.797
	Free-Meals Participation	NA				2	-.060	.008	.915
	Teacher's Judgment of CE Need	2	-.079	.005	.644	3	-.062	.004	.734
	Mother's Educational Attainment	3	.037	.001	.876	4	.050	.002	.844
	Frequency of Feedback per Semester	NA				8	.041	.002	.978
	Weekly Homework Assigned	NA				5	.060	.004	.996
	Individualization of Instruction	NA				7	-.042	.001	.944
	R^2 (R) for the Regression Model		.776 (.881)				.615 (.784)		
GRADE 5	Pretest Score	1	.822	.800		1	.741	.655	
	White/Minority Status	NA				4	.032	.001	.715
	Free-Meals Participation	2	-.079	.007	.809	2	-.046	.005	.850
	Teacher's Judgment of CE Need	3	-.039	.001	.651	3	-.056	.002	.704
	Mother's Educational Attainment	4	.022	<.001	.833	7	.024	.001	.849
	Effort in Curriculum Development	NA				6	-.042	.002	.964
	Effort in Planning and Evaluation	5	.029	.001	.994	NA			
	Teacher's Use of Lesson Plans	NA				5	.040	.001	.990
	Monthly Use of Materials	7	.025	.001	.908	NA			
	Individualization of Instruction	8	-.021	<.001	.897	NA			
	Monthly Use of Audio-Visual Equipment	6	-.028	.001	.930	NA			
	R^2 (R) for the Regression Model		.811 (.900)				.667 (.817)		
GRADE 6	Pretest Score	1	.828	.809		1	.748	.679	
	White/Minority Status	4	.044	.001	.860	5	.033	.001	.742
	Free-Meals Participation	NA				4	-.033	.001	.833
	Teacher's Judgment of CE Need	2	-.075	.004	.663	3	-.075	.004	.733
	Mother's Educational Attainment	3	.040	.002	.868	2	.061	.005	.924
	Effort in Curriculum Development	NA				11	-.023	<.001	.907
	Effort in Planning and Evaluation	8	.016	<.001	.959	NA			
	Teacher's Use of Lesson Plans	7	.023	.001	.991	10	-.024	.001	.987
	Frequency of Feedback per Semester	6	.024	.001	.981	9	.026	.001	.988
	Weekly Homework Assigned	5	.026	.001	.978	7	.034	.001	.974
	Individualization of Instruction	NA				6	.059	.002	.977
	Monthly Use of Audio-Visual Equipment	NA				8	-.032	.001	.844
	R^2 (R) for the Regression Model		.818 (.905)				.695 (.834)		

*Variables describing student's background and characteristics of educational practices that were employed as potential predictors are given in Table F-7. A criterion of 2.0 for the 'partial F-to-enter' was used for the selection of the prediction model presented here. In the forward stepwise selection procedure, background variables (the first listed) were given a higher priority of entry over the characteristics of educational practices, so that the background differences were adjusted in the assessment of the effects of the characteristics of educational practices. The 'Tolerance' column reports the proportion of variance of the predictor not explained by other predictors already entered into the regression model, so values near 1.0 indicate lack of collinearity among the predictors. (NA=Not Applicable.)

Table F-11

Effects of Characteristics of Classroom Organization on Student Achievement, Adjusted for Differences in Student Background Characteristics (Based on 15% Random Samples from Each Grade from the First-Year SES Data Base)

Selected Student Background Variables and Characteristics of Classroom Organization for the Prediction of Achievement Posttest Score*	Regression Model for Predicting Reading Posttest Score				Regression Model for Predicting Math Posttest Score			
	Entry Order*	Standardized Regression Coefficient	Increment in R^2 in Sequence	Tolerance	Entry Order*	Standardized Regression Coefficient	Increment in R^2 in Sequence	Tolerance
Grade 1								
Pretest Score	1	.528	.438		1	.579	.445	
Free-Meals Participation	4	-.039	.001	.783	3	-.056	.004	.875
Teacher's Judgment of CE Need	2	-.203	.038	.774	2	-.147	.023	.830
Mother's Educational Attainment	3	.065	.005	.871	4	.036	.001	.826
R^2 (R) for the Regression Model	.481 (.694)				.473 (.688)			
Grade 2								
Pretest Score	1	.660	.636		1	.647	.525	
White/Minority Status	4	.069	.004	.776	4	.030	.001	.888
Free-Meals Participation	3	-.066	.011	.893	NA			
Teacher's Judgment of CE Need	2	-.151	.015	.680	2	-.129	.016	.811
Mother's Educational Attainment	5	.048	.002	.823	3	.064	.004	.926
Classroom Achievement Level	NA				5	.031	.001	.998
Class Size	NA				6	-.028	.001	.974
R^2 (R) for the Regression Model	.671 (.819)				.548 (.740)			
Grade 3								
Pretest Score	1	.718	.707		1	.616	.538	
White/Minority Status	4	.043	.003	.857	3	.063	.007	.877
Free-Meals Participation	5	-.041	.001	.702	4	-.062	.003	.775
Teacher's Judgment of CE Need	2	-.114	.010	.610	2	-.167	.027	.750
Mother's Educational Attainment	3	.059	.004	.875	NA			
Classroom Achievement Level	NA				6	-.029	.001	.995
Class Size	NA				5	-.035	.001	.977
R^2 (R) for the Regression Model	.726 (.852)				.576 (.759)			
Grade 4								
Pretest Score	1	.810	.769		1	.701	.593	
White/Minority Status	4	.024	<.001	.886	NA			
Free-Meals Participation	NA				2	-.065	.008	.915
Teacher's Judgment of CE Need	2	-.079	.005	.644	3	-.077	.004	.734
Mother's Educational Attainment	3	.037	.001	.876	4	.051	.002	.844
Extent of Ability Grouping	NA				5	-.041	.002	.998
R^2 (R) for the Regression Model	.776 (.881)				.609 (.780)			
Grade 5								
Pretest Score	1	.825	.800		1	.749	.655	
White/Minority Status	NA				4	.042	.001	.715
Free-Meals Participation	2	-.084	.007	.809	2	-.048	.005	.850
Teacher's Judgment of CE Need	3	-.045	.001	.651	3	-.055	.002	.704
Mother's Educational Attainment	4	.021	<.001	.833	NA			
Classroom Achievement Level	5	.026	.001	.999	NA			
R^2 (R) for the Regression Model	.809 (.900)				.664 (.815)			
Grade 6								
Pretest Score	1	.826	.809		1	.755	.679	
White/Minority Status	4	.039	.001	.860	5	.027	.001	.742
Free-Meals Participation	NA				4	-.029	.001	.833
Teacher's Judgment of CE Need	2	-.075	.004	.663	3	-.071	.004	.733
Mother's Educational Attainment	3	.043	.002	.868	2	.059	.005	.924
R^2 (R) for the Regression Model	.816 (.903)				.690 (.831)			

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*Variables describing student's background and characteristics of classroom organization that were employed as potential predictors are given in Table F-7. A criterion of 2.0 for the 'partial F-to-enter' was used for the selection of the prediction model presented here. In the forward stepwise selection procedure, background variables (the first listed) were given a higher priority of entry over the characteristics of classroom organization, so that the background differences were adjusted in the assessment of the effects of the characteristics of classroom organization. The 'Tolerance' column reports the proportion of variance of the predictor not explained by other predictors already entered into the regression model, so values near 1.0 indicate lack of collinearity among the predictors. (NA = Not Applicable.)

Table F-12

Full-Model Regression of Reading Posttest Score on Selected Student Background and Education-Process Variables (Based on 15% Random Samples from Each Grade from the First-Year SES Data Base)*

Selected Student Background Variables and Characteristics of Educational Processes for the Prediction of Reading Achievement Posttest Score**	Standardized Regression Coefficient (Beta)											
	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta
Background Variables												
Pretest VSS Score	1	.523	1	.651	1	.697	1	.812	1	.809	1	.818
White/Minority Status	NA		4	.051	4	-.002	4	.063	11	.021	4	.029
Free-Meals Participation	4	-.063	3	-.054	5	-.028	NA		2	-.068	NA	
Teacher's Judgment of CE Need	2	-.219	2	-.153	2	-.114	2	-.074	3	-.043	2	-.079
Mother's Educational Attainment	3	.071	5	.050	3	.052	3	.035	4	.024	3	.033
Characteristics of Instructional Personnel												
Staff/Student Ratio	NA		NA		9	.029	NA		NA		NA	
Support/Teaching Personnel Ratio	NA		NA		NA		NA		NA		10	-.018
Years of Teaching	5	.069	7	.041	11	.022	6	.033	7	.024	NA	
Highest Degree Earned	NA		NA		10	.023	NA		NA		NA	
Recent Inservice Training	15	.029	NA		NA		NA		NA		5	.033
Attitude to School Programs	NA		8	-.033	NA		NA		NA		NA	
Characteristics of Educational Environment												
School's Minority Concentration	NA		NA		NA		5	.053	NA		NA	
School's CE Concentration	7	.071	10	.029	NA		NA		NA		NA	
School's Low-Achiever Concentration	NA		6	-.051	6	-.101	NA		NA		7	-.040
School's Central Resources	13	.032	NA		NA		NA		NA		NA	
Parent/Community Involvement	8	-.094	NA		NA		NA		10	.030	NA	
District Control of Instruction	14	.029	NA		NA		NA		NA		NA	
Principal's Instructional Leadership	6	.055	NA		8	-.024	NA		NA		NA	
Disturbance of Instruction	10	.053	NA		NA		NA		5	-.029	NA	
District's Percent of Administrative Staff	NA		9	-.027	7	.035	NA		NA		NA	
Characteristics of Educational Practices												
Effort in Planning and Evaluation	NA		NA		NA		NA		8	.030	NA	
Teacher's Use of Lesson Plans	11	.038	NA		NA		NA		NA		9	.025
Frequency of Feedback per Semester	NA		NA		NA		NA		NA		8	.027
Weekly Homework Assigned	12	.034	NA		NA		NA		NA		6	.026
Monthly Use of Materials	NA		NA		NA		NA		13	.024	NA	
Individualization of Instruction	NA		NA		NA		NA		9	-.026	NA	
Monthly Use of Audio-Visual Equipment	9	.048	11	-.025	NA		NA		12	-.027	NA	
Characteristics of Classroom Organization												
Classroom Achievement Level	NA		NA		NA		NA		6	.031	NA	
R^2 (R) for the Regression Model	.509(.713)		.676(.822)		.735(.857)		.778(.882)		.814(.902)		.820(.906)	

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[*] Educational process variables involved in the present analyses as potential predictors include those already selected in the sub-analyses that examine four subsets of the process variables -- characteristics of instructional personnel, educational environment, educational practices, and classroom organization. The results of these sub-analyses are summarized in Tables F-8 to F-11 by grades.

[**] The same stepwise regression strategy employed in the sub-analyses was adopted here for the full-model analyses. In particular, student background variables were given priorities of entry over the education-process variables. (NA = Not Applicable.)

Table F-13

Full-Model Regression of Math Posttest Score on Selected Student Background and Education-Process Variables (Based on 15% Random Samples from Each Grade from the First-Year SES Data Base)*

Selected Student Background Variables and Characteristics of Educational Processes for the Prediction of Math Achievement Posttest Score**	Standardized Regression Coefficient (Beta)											
	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta	Entry Order	Beta
Background Variables												
Pretest VSS Score	1	.570	1	.629	1	.585	1	.677	1	.720	1	.749
White/Minority Status	NA		4	.052	3	.003	6	.030	4	.016	5	.049
Free-Meals Participation	3	-.041	NA		4	-.011	2	-.042	2	-.040	4	-.039
Teacher's Judgment of CE Need	2	-.145	2	-.139	2	-.142	3	-.060	3	-.058	3	-.080
Mother's Educational Attainment	4	.036	3	.053	NA		4	.042	6	.027	2	.058
Characteristics of Instructional Personnel												
Support/Teaching Personnel Ratio	NA		NA		NA		NA		12	.028	10	-.036
Years of Teaching	10	.033	5	.090	NA		8	.045	11	.030	9	.050
Recent Inservice Training	11	.032	NA		10	-.034	14	.030	NA		NA	
Belief in Schooling	8	.047	NA		NA		NA		NA		7	-.053
Attitude to School Programs	NA		NA		NA		NA		14	.029	NA	
Characteristics of Educational Environment												
School's Minority Concentration	NA		10	.066	7	.092	11	.074	NA		NA	
School's Poverty Concentration	NA		NA		NA		NA		8	.050	11	.041
School's CE Concentration	NA		NA		NA		10	-.043	NA		NA	
School's Low Achiever Concentration	6	-.063	9	-.080	5	-.280	7	-.088	5	-.089	NA	
School's Central Resources	9	.044	NA		NA		NA		NA		NA	
Parent/Community Involvement	NA		7	.056	NA		NA		10	.045	NA	
Principal's Instructional Leadership	NA		NA		NA		12	-.032	NA		NA	
Teacher's Involvement in Decisions	NA		8	-.042	NA		NA		15	-.026	NA	
Disturbance of Instruction	NA		NA		NA		NA		7	-.048	NA	
District's Testing Program	NA		NA		11	-.031	NA		NA		NA	
District's Percent of Administrative Staff	NA		NA		6	.049	NA		NA		NA	
Characteristics of Educational Practices												
Effort in Curriculum Development	NA		NA		NA		NA		9	-.037	14	-.021
Teacher's Use of Lesson Plans	7	-.041	NA		NA		NA		13	.025	NA	
Frequency of Feedback per Semester	NA		NA		12	.029	13	.034	NA		13	.026
Weekly Homework Assigned	5	.046	11	.035	NA		5	.059	NA		8	.042
Monthly Use of Materials	NA		6	.044	NA		NA		NA		NA	
Individualization of Instruction	NA		NA		8	-.055	15	-.027	NA		6	.058
Monthly Use of Audio-Visual Equipment	NA		NA		9	.036	NA		NA		12	-.026
Characteristics of Classroom Organization												
Extent of Ability Grouping	NA		NA		NA		9	-.046	NA		NA	
Class Size	NA		12	-.030	13	-.029	NA		NA		NA	
R^2(R) for the Regression Model	.485(.696)		.565(.752)		.617(.786)		.626(.791)		.677(.823)		.700(.837)	

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*Educational Process variables involved in the present analyses as potential predictors include those already selected in the sub-analyses that examine four subsets of the process variables -- Characteristics of instructional personnel, educational environment, educational practices, and classroom organization. The results of these sub-anzlyses are summarized in Tables F-8 to F-11 by grades.

**The same stepwise regression strategy employed in the sub-analyses was adopted here for the full-model analyses. In particular, student background variables were given priorities of entry over the education-process variables. (NA = Not Applicable.)

Table F-14

Correlations of Student-Background Variables and Education-Process Variables with Posttest Student Affect Scores (Based on 15% Random Samples from Each Grade from the First-Year SES Data Base)*

Background Variables and Variables Describing the Educational Processes**	Grade	2	3	4	5	6
	N =	1,197	1,164	1,104	1,217	1,330
Background Variables						
Pretest Student Affect Score		.47	.50	.54	.59	.63
White/Minority Status		-.16	-.20	-.16	-.21	-.23
Free-Meals Participation		.13	.20	.18	.14	.13
Teacher's Judgment of CE Need (Reading and/or Math)		.02	.07	.06	.08	.04
Mother's Educational Attainment		-.09	-.07	-.05	-.06	-.05
Characteristics of Instructional Personnel						
Staff/Student Ratio		.02	.04	.03	.02	-.02
Support/Teaching Personnel Ratio		-.00	.04	.06	-.00	-.04
Years of Teaching (Reading Teacher)		.04	-.03	.02	.05	.04
Years of Teaching (Math Teacher)		.07	-.00	-.04	.00	-.04
Highest Degree Earned (Reading Teacher)		-.02	-.02	-.00	.06	-.04
Highest Degree Earned (Math Teacher)		-.02	-.02	.01	.06	-.01
Recent Inservice Training (Reading Teacher)		.04	.05	.08	.04	.07
Recent Inservice Training (Math Teacher)		.06	.05	.01	.03	.10
Belief in Schooling (Reading Teacher)		-.01	.05	.05	.03	-.01
Belief in Schooling (Math Teacher)		.01	.05	.03	.05	.04
Attitude to School Programs (Reading Teacher)		-.01	-.07	-.04	-.01	.04
Attitude to School Programs (Math Teacher)		-.01	-.07	-.10	-.04	.02
Characteristics of Educational Environment						
School's Minority Concentration		.16	.21	.18	.22	.21
School's Poverty Concentration		.14	.22	.20	.23	.20
School's Reading CE Concentration		.06	.08	.02	.09	.14
School's Math CE Concentration		.02	.09	-.00	.11	.15
School's Reading Low-Achiever Concentration		.16	.22	.17	.20	.19
School's Math Low-Achiever Concentration		.15	.21	.18	.19	.17
School's Reading Central Resources		-.01	.02	-.04	-.01	-.01
School's Math Central Resources		.05	.07	.04	.06	.02
Student Mobility Rate		-.01	.04	.08	.10	.11
Parent/Community Involvement		.03	.06	.00	.10	.11
District Control of Instruction		.02	-.01	.00	.07	.04
Principal's Instructional Leadership		.02	-.02	.01	.01	.04
Teacher's Involvement in Decisions		-.06	-.06	-.04	-.08	.02
Disturbance of Instruction		.04	.09	.11	.04	.07
District's Testing Program		.04	-.00	-.01	.02	-.01
District's Percent of Administrative Staff		.04	.03	.06	.03	.06
Characteristics of Educational Practices						
Effort in Curriculum Development (Reading Teacher)		.03	.06	.05	.08	.07
Effort in Curriculum Development (Math Teacher)		-.01	.07	.03	.00	.04
Effort in Planning and Evaluation (Reading Teacher)		.01	-.02	.06	.02	.04
Effort in Planning and Evaluation (Math Teacher)		.02	-.03	.02	.06	.05
Reading Teacher's Use of Lesson Plans		-.04	.03	-.02	-.02	-.03
Math Teacher's Use of Lesson Plans		.01	.02	-.01	.01	-.04
Reading Teacher's Frequency of Feedback per Semester		-.06	.03	.03	.08	.02
Math Teacher's Frequency of Feedback per Semester		-.05	.05	-.01	.09	.00
Weekly Reading Homework Assigned		.10	.09	-.00	-.01	.11
Weekly Math Homework Assigned		.14	.10	.02	.02	.00
Monthly Use of Reading Materials		.02	.01	-.05	.06	.04
Monthly Use of Math Materials		.02	.05	.01	.04	.04
Individualization of Reading Instruction		.04	.02	.01	.07	.13
Individualization of Math Instruction		-.04	-.01	.05	.07	.10
Monthly Use of Audio-Visual Equipment in Reading		.02	.05	.02	.12	.08
Monthly Use of Audio-Visual Equipment in Math		.02	.06	.00	.01	.06

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[*] The Student Affective Measure (SAM) was not administered to the first graders in the fall so that the analyses in this section were not performed for grade one.

[**] Some variables have been aggregated to classroom (Teacher) or school levels. The following categorical variables have been specially coded for the present analyses: Teacher's Judgment of CE Need (0 = no need of CE in both reading and math, 1 = Need CE in reading and/or math); School's Central Resources (0 = no resource center in subject area; 1 = presence of resource center in subject area); Teacher's Use of Lesson Plans (0 = lesson plans in subject area are not used; 1 = lesson plans in subject area are used).

Table F-15

Effects of Characteristics of Instructional Personnel on Student Affect, Adjusted for Differences in Student Background Characteristics

(Based on 15% Random Samples from Each Grade from The First-Year SES Data Base)

Selected Student Background Variables and Characteristics of Instructional Personnel for the Prediction of Posttest Student Affect Score*	Entry Order	Standardized Regression Coefficient	Increment in R^2 in Sequence	Tolerance
Grade 2				
Pretest Student Affect Score	1	.452	.223	
White/Minority Status	2	-.085	.007	.975
Mother's Educational Attainment	3	-.045	.002	.967
Years of Teaching (Math Teacher)	4	.131	.004	.982
Years of Teaching (Reading Teacher)	5	-.079	.001	.211
R^2(R) for the Regression Model		.236 (.486)		
Grade 3				
Pretest Student Affect Score	1	.474	.249	
Free-Meals Participation	2	.108	.016	.978
White/Minority Status	3	-.048	.002	.785
Attitude to School Programs (Math Teacher)	4	-.044	.002	.983
Highest Degree Earned (Reading Teacher)	5	-.043	.002	.987
R^2(R) for the Regression Model		.272 (.521)		
Grade 4				
Pretest Student Affect Score	1	.515	.287	
Free-Meals Participation	2	.081	.010	.979
White/Minority Status	3	-.021	.002	.831
Recent Inservice Training (Reading Teacher)	4	.049	.003	.951
Attitude to School Programs (Math Teacher)	5	-.091	.002	.933
Attitude to School Programs (Reading Teacher)	6	.054	.001	.441
R^2(R) for the Regression Model		.305 (.552)		
Grade 5				
Pretest Student Affect Score	1	.574	.352	
White/Minority Status	2	-.050	.006	.944
Free-Meals Participation	3	.050	.002	.745
Highest Degree Earned (Math Teacher)	4	.051	.003	.995
Years of Teaching (Reading Teacher)	5	.039	.002	.997
R^2(R) for the Regression Model		.363 (.603)		
Grade 6				
Pretest Student Affect Score	1	.607	.398	
White/Minority Status	2	-.106	.007	.947
Attitude to School Programs (Reading Teacher)	3	.081	.005	.956
Years of Teaching (Math Teacher)	4	-.072	.003	.971
Staff/Student Ratio	5	-.042	.002	.997
Years of Teaching (Reading Teacher)	6	.039	.001	.710
Recent Inservice Training (Math Teacher)	7	.053	.001	.972
Recent Inservice Training (Reading Teacher)	8	-.039	.001	.636
R^2(R) for the Regression Model		.418 (.647)		

*Variables describing student's background and characteristics of instructional personnel that were employed as potential predictors are given in Table F-14. A criterion of 2.0 for the 'partial F-to-Enter' was used for the selection of the prediction model presented here. In the forward stepwise selection procedure, background variables (the first listed) were given a higher priority of entry over the characteristics of instructional personnel, so that the background differences were adjusted in the assessment of the effects of the characteristics of instructional personnel. The 'Tolerance' column reports the proportion of variance of the predictor not explained by other predictors already entered into the regression model, so values near 1.0 indicate lack of collinearity among the predictors.

Table F-16

Effects of Characteristics of Educational Environment on Student Affect, Adjusted for Differences in Student Background Characteristics (Based on 15% Random Samples from Each Grade from the First-Year SES Data Base)

Selected Student Background Variables and Characteristics of Educational Environment for the Prediction of Posttest Student Affect Score*	Entry Order	Standardized Regression Coefficient	Increment in R^2 in Sequence	Tolerance
Grade 2				
Pretest Student Affect Score	1	.454	.223	
White/Minority Status	2	-.039	.007	.975
Mother's Educational Attainment	3	-.032	.002	.967
School's Reading Low-Achiever Concentration	4	.100	.005	.670
School's Math CE Concentration	5	-.051	.002	.843
R^2 (R) for the Regression Model		.238 (.488)		
Grade 3				
Pretest Student Affect Score	1	.471	.249	
Free-Meals Participation	2	.082	.016	.978
White/Minority Status	3	-.001	.002	.785
School's Reading Low-Achiever Concentration	4	.108	.006	.587
Teacher's Involvement in Decisions	5	-.085	.005	.999
School's Reading Central Resources	6	.065	.004	.926
R^2 (R) for the Regression Model		.282 (.531)		
Grade 4				
Pretest Student Affect Score	1	.512	.287	
Free-Meals Participation	2	.074	.010	.979
White/Minority Status	3	.008	.002	.831
School's Minority Concentration	4	.079	.003	.442
District's Percent of Administrative Staff	5	.051	.003	.985
School's Math Central Resources	6	.102	.002	.953
School's Reading Central Resources	7	-.066	.004	.744
Disturbance of Instruction	8	.062	.002	.947
Principal's Instructional Leadership	9	-.047	.002	.843
School's Math CE Concentration	10	-.046	.002	.878
R^2 (R) for the Regression Model		.317 (.563)		
Grade 5				
Pretest Student Affect Score	1	.564	.352	
White/Minority Status	2	-.026	.006	.944
Free-Meals Participation	3	.005	.002	.745
School's Poverty Concentration	4	.098	.005	.532
District's Percent of Administrative Staff	5	.043	.002	.993
Teacher's Involvement in Decisions	6	-.044	.002	.980
Disturbance of Instruction	7	-.044	.001	.863
Student Mobility Rate	8	.039	.001	.878
R^2 (R) for the Regression Model		.370 (.609)		
Grade 6				
Pretest Student Affect Score	1	.606	.398	
White/Minority Status	2	-.074	.007	.947
School's Math CE Concentration	3	.050	.003	.911
District's Percent of Administrative Staff	4	.032	.001	.992
R^2 (R) for the Regression Model		.409 (.639)		

*Variables describing student's background and characteristics of educational environment that were employed as potential predictors are given in Table F-14. A criterion of 2.0 for the 'partial F-to-Enter' was used for the selection of the prediction model presented here. In the forward stepwise selection procedure, background variables (the first listed) were given a higher priority of entry over the characteristics of educational environment, so that the background differences were adjusted in the assessment of the effects of the characteristics of educational environment. The 'Tolerance' column reports the proportion of variance of the predictor not explained by other predictors already entered into the regression model, so values near 1.0 indicate lack of collinearity among the predictors.

Table F-17

Effects on Characteristics of Educational Practices on Student Affect, Adjusted for Differences in Student Background Characteristics (Based on 15% Random Samples from Each Grade from the First-Year SES Data Base)

Selected Student Background Variables and Characteristics of Educational Practices for the Prediction of Posttest Student Affect Score*	Entry Order	Standardized Regression Coefficient	Increment in R^2 in Sequence	Tolerance
Grade 2				
Pretest Student Affect Score	1	.452	.223	
White/Minority Status	2	-.054	.007	.975
Mother's Educational Attainment	3	-.044	.002	.967
Weekly Math Homework Assigned	4	.071	.005	.911
Reading Teacher's Frequency of Feedback per Semester	5	-.051	.003	.989
R^2 (R) for the Regression Model		.239 (.489)		
Grade 3				
Pretest Student Affect Score	1	.470	.249	
Free-Meals Participation	2	.110	.016	.978
White/Minority Status	3	-.055	.002	.785
Reading Teacher's Use of Lesson Plans	4	.067	.004	.970
Weekly Reading Homework Assigned	5	.058	.004	.980
Math Teacher's Frequency of Feedback per Semester	6	.043	.002	.989
R^2 (R) for the Regression Model		.277 (.527)		
Grade 4				
Pretest Student Affect Score	1	.516	.287	
Free-Meals Participation	2	.086	.010	.979
White/Minority Status	3	-.041	.002	.831
Effort in Planning and Evaluation (Reading Teacher)	4	.055	.003	.998
R^2 (R) for the Regression Model		.301 (.549)		
Grade 5				
Pretest Student Affect Score	1	.572	.352	
White/Minority Status	2	-.059	.006	.944
Free-Meals Participation	3	.046	.002	.745
Math Teacher's Frequency of Feedback per Semester	4	.067	.004	.999
Weekly Reading Homework Assigned	5	-.037	.001	.975
R^2 (R) for the Regression Model		.365 (.604)		
Grade 6				
Pretest Student Affect Score	1	.607	.398	
White/Minority Status	2	-.074	.007	.947
Individualization of Reading Instruction	3	.042	.004	.966
Individualization of Math Instruction	4	.039	.002	.885
Effort in Curriculum Development (Reading Teacher)	5	.033	.001	.955
R^2 (R) for the Regression Model		.411 (.641)		

*Variables describing student's background and characteristics of educational practices that were employed as potential predictors are given in Table F-14. A criterion of 2.0 for the 'partial F-to-Enter' was used for the selection of the prediction model presented here. In the forward stepwise selection procedure, background variables (the first listed) were given a higher priority of entry over the characteristics of educational practices, so that the background differences were adjusted in the assessment of the effects of the characteristics of educational practices. The 'Tolerance' column reports the proportion of variance of the predictor not explained by other predictors already entered into the regression model, so values near 1.0 indicate lack of collinearity among the predictors.

APPENDIX G

SUPPLEMENTARY TABLES FOR CHAPTER 7

Table G-1

Estimated Standard Deviations for Z-Score Gains

Grade	Reading		Math	
	RTT*	ZSD*	RTT	ZSD
1	.59	.906	.62	.872
2	.76	.693	.67	.812
3	.81	.616	.71	.762
4	.81	.616	.73	.735
5	.88	.490	.77	.678
6	.89	.469	.80	.632

* RTT = Average test-retest (fall to spring) correlation (from Table 1-15 of Report 9)

ZSD = Standard Deviation of z-score gain (= $\sqrt{2(1-RTT)}$).

Table G-2

Percentage of Students Whose Fall-to-Spring Growth Is At Least One Standard Deviation Above or Below the Average of Their Peers With Comparable Fall Achievement Status, by CE Category*

GRADE	Categories of Fall-to-Spring Growth*	CE Selection Category												Total	
		Title I Students in Title I Schools		Other-CE Students in Title I Schools		CE Students in Other-CE Schools		Non-CE Students in Title I Schools		Non-CE Students in Other-CE Schools		Students in Non-CE Schools			
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
	Reading Achievement**														
1	High	202	7.3	70	7.1	38	6.6	778	10.9	291	9.0	220	10.2	1,599	9.5
	Average	2,228	80.0	788	79.8	438	76.3	5,664	79.3	2,582	79.7	1,717	79.8	13,417	79.5
	Low	355	12.8	129	13.1	98	17.1	698	9.8	365	11.3	214	10.0	1,859	11.0
	Total	2,785	100.1	987	100.0	574	100.0	7,140	100.0	3,238	100.0	2,151	100.0	16,875	100.0
2	High	271	8.9	72	7.6	84	11.9	522	8.7	256	9.0	158	8.1	1,363	8.8
	Average	2,420	79.7	751	79.2	555	78.8	4,865	80.7	2,322	81.7	1,549	79.3	12,462	80.3
	Low	345	11.4	125	13.2	65	9.2	640	10.6	264	9.3	247	12.6	1,686	10.9
	Total	3,036	100.0	948	100.0	704	99.9	6,027	100.0	2,842	100.0	1,954	100.0	15,511	100.0
3	High	264	8.7	78	8.8	68	10.8	536	9.0	296	10.1	189	9.8	1,431	9.3
	Average	2,476	81.9	693	78.4	499	79.3	4,929	82.5	2,383	81.4	1,563	80.7	12,543	81.6
	Low	282	9.3	113	12.8	62	9.9	512	8.6	248	8.5	186	9.6	1,403	9.1
	Total	3,022	99.9	884	100.0	629	100.0	5,977	100.1	2,927	100.0	1,938	100.1	15,377	100.0
4	High	200	8.4	61	7.1	58	9.4	450	7.0	247	7.8	171	8.8	1,187	7.7
	Average	1,881	78.6	703	81.4	484	78.2	5,522	85.6	2,645	83.4	1,619	82.8	12,854	83.2
	Low	311	13.0	100	11.6	77	12.4	480	7.4	280	8.8	165	8.4	1,413	9.1
	Total	2,392	100.0	864	100.1	619	100.0	6,452	100.0	3,172	100.0	1,955	100.0	15,454	100.0
5	High	181	8.1	51	6.4	66	11.2	599	8.8	383	10.6	210	9.5	1,490	9.2
	Average	1,752	78.7	649	80.9	443	75.5	5,517	81.0	2,865	79.5	1,781	80.8	13,007	80.1
	Low	294	13.2	102	12.7	78	13.3	694	10.2	355	9.9	214	9.7	1,737	10.7
	Total	2,227	100.0	802	100.0	587	100.0	6,810	100.0	3,603	100.0	2,205	100.0	16,234	100.0
6	High	235	11.9	99	10.9	40	6.5	697	10.1	582	10.0	249	9.9	1,902	10.2
	Average	1,500	75.7	705	77.9	484	78.1	5,468	79.4	4,494	77.4	1,987	79.0	14,638	78.2
	Low	247	12.5	101	11.2	96	15.5	726	10.5	729	12.6	279	11.1	2,178	11.6
	Total	1,982	100.1	905	100.0	620	100.1	6,891	100.0	5,805	100.0	2,515	100.0	18,718	100.0
	Math Achievement**														
1	High	182	11.4	81	9.5	49	14.9	1,019	12.1	340	9.8	195	9.2	1,866	11.1
	Average	1,253	78.4	662	77.4	236	71.7	539	77.5	2,745	78.8	1,663	78.0	13,098	77.8
	Low	163	10.2	112	13.1	44	13.4	882	10.5	399	11.5	274	12.9	1,874	11.1
	Total	1,598	100.0	855	100.0	329	100.0	8,440	100.1	3,484	100.1	2,132	100.0	16,838	100.0
2	High	143	8.5	58	7.2	33	11.3	755	10.1	330	10.2	174	8.9	1,493	9.7
	Average	1,337	79.3	654	80.9	219	75.3	5,938	79.2	2,617	80.6	1,534	78.8	12,299	79.5
	Low	206	12.2	96	11.9	39	13.4	806	10.8	300	9.2	239	12.3	1,686	10.9
	Total	1,686	100.0	908	100.0	291	100.0	7,499	100.1	3,247	100.0	1,947	100.0	15,478	100.1
3	High	165	9.2	62	8.1	26	7.1	653	8.9	250	7.8	202	10.4	1,358	8.8
	Average	1,459	81.4	586	76.3	273	74.0	5,868	80.4	2,654	83.2	1,518	78.2	12,358	80.5
	Low	169	9.4	120	15.6	70	19.0	780	10.7	285	8.9	222	11.4	1,646	10.7
	Total	1,793	100.0	768	100.0	369	100.1	7,301	100.0	3,189	99.9	1,942	100.0	15,362	100.0
4	High	164	11.4	78	9.2	26	7.0	697	9.4	337	9.9	233	11.9	1,535	10.0
	Average	1,134	79.1	655	77.5	280	75.1	5,908	79.9	2,720	79.7	1,489	76.2	12,186	79.1
	Low	136	9.5	112	13.3	67	18.0	790	10.7	358	10.5	232	11.9	1,695	11.0
	Total	1,434	100.0	845	100.0	373	100.1	7,395	100.0	3,415	100.1	1,954	100.0	15,416	100.1
5	High	130	9.8	59	7.7	37	9.3	733	9.5	427	11.3	257	11.7	1,643	10.1
	Average	1,100	82.6	606	78.9	325	81.3	6,168	79.8	2,999	79.2	1,732	78.6	12,930	79.7
	Low	101	7.6	103	13.4	38	9.5	828	10.7	361	9.5	214	9.7	1,645	10.1
	Total	1,331	100.0	768	100.0	400	100.1	7,729	100.0	3,787	100.0	2,203	100.0	16,218	99.9
6	High	128	11.3	82	9.6	30	6.6	756	9.7	611	10.3	227	9.1	1,834	9.8
	Average	887	78.2	676	78.8	369	80.7	6,048	77.8	4,491	75.4	1,939	77.7	14,410	77.2
	Low	119	10.5	100	11.7	58	12.7	970	12.5	858	14.4	329	13.2	2,434	13.0
	Total	1,134	100.0	858	100.1	457	100.0	7,774	100.0	5,960	100.1	2,495	100.0	18,678	100.0

[*] Categories of Fall-to-Spring Growth are defined in terms of the average and standard deviation of the growth for subgroups of students with comparable fall achievement status: High = at least one s.d. above the average, Average = within ± one s.d. of the average, and Low = at least one s.d. below the average.

[**] Chi-Square statistics show significant associations between CE status and growth category at the .01 level in all cases.

Table G-3

Means of the Potential Discriminating Variables Employed in the Discriminant Analysis for the Two Groups of Students Whose Fall-to-Spring Achievement Growth *in Reading* is One Standard Deviation Above ('High' Growth) or Below ('Low' Growth) the Average of Their Peers with Comparable Fall Achievement

Potential Discriminating Variables	Means for the 'High' and 'Low' Achievement Growth Groups											
	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
N =	1,426	1,612	1,236	1,461	1,312	1,240	1,024	1,212	1,293	1,498	1,611	1,770
Student Characteristics												
Pretest Achievement Quartile	2.16*	2.84*	2.10*	2.73*	2.09*	2.71*	2.11*	2.32*	2.26*	2.39*	2.37*	2.56*
Participation in Compensatory Education	.19*	.30*	.28	.30	.28	.31	.28*	.35*	.19*	.26*	.19	.19
Instructional Services Received Per Year												
Regular Instruction	148.49*	124.07*	128.29	120.00	105.03	104.26	99.78	94.37	101.16*	90.27*	96.77	91.84
Special Instruction	50.96*	65.43*	55.73*	62.67*	50.64	55.36	39.92*	48.17*	30.55*	37.01*	29.09	29.09
Tutor/Independent Work	111.03*	103.21*	103.42	100.53	93.66*	87.06*	72.55	71.67	66.34	68.52	61.85	59.47
Characteristics of Educational Process												
Staff/Student Ratio	.06*	.07*	.07*	.07*	.07	.07	.07	.07	.07*	.07*	.07	.07
Support/Teaching Personnel Ratio	.13*	.14*	.14*	.16*	.14	.14	.16	.15	.17*	.15*	.19*	.21*
Years of Teaching	11.85*	10.30*	12.87*	10.82*	12.11*	11.15*	12.20	11.66	11.98	11.27	11.28*	10.24*
Highest Degree Earned	2.40	2.41	2.51	2.47	2.51	2.49	2.55	2.54	2.52	2.53	2.53	2.56
Recent Inservice Training	13.28*	11.29*	11.56	13.12	11.18	10.85	12.40	11.28	9.70	10.90	11.83*	9.40*
Attitude to School Programs	11.71*	11.42*	11.23	11.10	11.10	11.29	10.74	10.88	11.05	10.77	10.57	10.50
School's Minority Concentration	36.42*	32.96*	31.31*	43.56*	34.78	36.54	40.08	37.34	30.50*	37.50*	34.27	32.67
School's CE Concentration	24.39	22.91	23.59	24.99	24.31	25.68	25.06	26.79	19.41*	22.47*	20.25*	18.06*
School's Low-Achiever Concentration	38.01	37.68	37.45*	42.22*	38.83	39.98	40.26	39.80	35.96*	40.47*	37.67	37.38
School's Central Resources	.67*	.61*	.65	.66	.71	.69	.66	.66	.61	.60	.60*	.53*
Parent/Community Involvement	45.46	45.20	46.37	45.98	45.24	45.84	45.22	45.00	43.51	43.94	42.79*	41.25*
District Control of Instruction	41.68	41.61	41.31	41.79	41.28	41.55	41.35	41.53	41.36	41.45	41.65	41.77
Principal's Instructional Leadership	54.44	53.85	53.78	54.17	53.48	54.15	53.34	53.60	53.63	53.42	53.28	53.05
Disturbance of Instruction	52.55	51.47	51.74*	53.79*	51.02	52.39	51.37	52.98	50.98*	54.36*	54.03	55.34
District's Percent of Administrative Staff	4.80	4.85	4.80*	5.06*	4.90	4.70	4.74	4.97	4.88*	5.15*	4.96	5.09
Effort in Planning and Evaluation	23.52	22.89	23.67	23.26	23.06*	21.81*	22.69	22.47	21.99	21.71	21.46*	20.46*
Teacher's Use of Lesson Plans	.96	.97	.92	.94	.93	.93	.95	.93	.96	.95	.96*	.94*
Frequency of Feedback per Semester	125.27	125.82	129.80*	121.52*	122.35	116.87	107.89	101.28	96.83	90.99	83.20	78.38
Weekly Homework Assigned	.62*	.50*	.67	.60	.62	.57	.71	.78	.84	.79	.87	.82
Monthly Use of Materials	81.24*	75.45*	78.91	77.36	71.94	70.53	64.91	64.68	62.18	62.98	59.04	57.27
Individualization of Instruction	20.04	19.97	20.15	19.99	20.66	20.54	20.50	20.71	19.79*	20.34*	20.18	19.95
Monthly Use of Audio-Visual Equipment	24.84	23.16	22.50	23.17	22.08	20.87	20.32	20.53	16.49	17.81	16.25	15.17
Classroom Achievement Level	.66	.61	.53	.52	.53	.50	.46	.47	.40	.44	.40	.42

*Means for the two groups differ significantly at the .01 level.

Table G-4

Means of the Potential Discriminating Variables Employed in the Discriminant Analysis for the Two Groups of Students Whose Fall-to-Spring Achievement Growth *in Math* is One Standard Deviation Above ('High' Growth) or Below ('Low' Growth) the Average of Their Peers with Comparable Fall Achievement

Potential Discriminating Variables	Means for the 'High' and 'Low' Achivement Growth Groups											
	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
N =	1,639	1,572	1,328	1,432	1,192	1,385	1,301	1,423	1,347	1,337	1,570	2,003
Student Characteristics												
Pretest Achievement Quartile	2.05*	2.78*	2.02*	2.76*	1.98*	2.86*	2.04*	2.80*	2.16*	2.67*	2.21*	2.77*
Participation in Compensatory Education	.17	.16	.15*	.19*	.18	.20	.18	.18	.14	.14	.13	.11
Instructional Services Received per Year												
Regular Instruction	89.98	85.97	97.47*	89.83*	91.63*	86.61*	94.25	94.33	103.27*	97.04*	102.53	102.30
Special Instruction	18.33	17.23	17.98	20.70	19.08	22.10	25.90*	18.70*	20.50	23.05	17.49	16.72
Tutor/Independent Work	62.90*	56.49*	58.92*	62.68*	64.65	62.00	57.39	56.69	50.66	49.49	45.93	43.66
Characteristics of Educational Process												
Support/Teaching Personnel Ratio	.14*	.15*	.14	.14	.13	.13	.14	.14	.15	.15	.19*	.22*
Years of Teaching	11.65	11.09	13.45*	11.23*	11.60*	10.81*	12.37	12.12	11.88*	10.48*	11.56	11.01
Recent Inservice Training	11.53*	9.72*	10.88	9.77	9.14*	10.71*	9.29	8.62	8.34	7.50	6.20	5.68
Belief in Schooling	5.81*	5.62*	5.75	5.82	5.82	5.70	5.65	5.58	5.64	5.72	5.35	5.41
Attitude to School Programs	11.55*	11.28*	11.22*	10.82*	11.19	11.21	10.95	10.77	11.21*	10.56*	10.96*	10.72*
School's Minority Concentration	38.34	36.66	35.05*	39.96*	31.60*	40.24*	33.98	33.41	27.59*	35.46*	29.31	29.51
School's Poverty Concentration	45.88	44.10	41.45*	45.06*	40.57*	46.58*	41.04	41.46	36.52*	43.80*	35.59	35.14
School's CE Concentration	18.48*	14.98*	15.37	16.71	14.21*	18.21*	13.89*	17.35*	11.70*	13.91*	12.61	11.48
School's Low-Achiever Concentration	39.18	38.94	37.50	39.08	35.98*	41.35*	36.74	37.14	34.08*	39.09*	35.58	34.73
School's Central Resources	.44*	.38*	.39	.39	.35	.39	.33	.36	.30	.27	.26	.26
Parent/Community Involvement	45.14	46.07	44.48	45.52	43.95*	46.76*	43.82*	45.87*	43.79	43.05	41.62	40.60
Principal's Instructional Leadership	53.93	54.27	55.52	53.68	52.78*	54.50*	53.35	53.81	53.37	53.14	52.90	53.31
Teacher's Involvement in Decisions	39.38	39.83	39.25	39.79	38.93*	39.70*	38.86*	39.79*	38.61	38.77	39.02	39.15
Disturbance of Instruction	52.28	53.23	52.21	51.93	50.62*	53.83*	49.44*	53.20*	49.49*	55.16*	53.32*	56.66*
District's Testing Program	.99	.99	.99	.99	.98	.98	.97	.98	.98	.97	.98	.99
District's Percent of Administrative Staff	4.88	4.75	4.86	4.83	4.81	4.63	4.66*	4.96*	4.79*	5.19*	4.93	4.76
Effort in Curriculum Development	12.23	11.91	12.51	12.93	10.55*	11.81*	12.96	12.00	12.20	11.86	12.76	12.70
Teacher's Use of Lesson Plans	.96	.97	.95	.96	.94	.92	.95	.95	.96*	.92*	.98	.97
Frequency of Feedback per Semester	139.63*	129.55*	144.80*	134.69*	133.71*	125.29*	138.13*	129.04*	129.34*	122.31*	120.71*	108.93*
Weekly Homework Assigned	.36*	.30*	.50	.48	.81	.86	1.02	.93	1.22	1.25	1.39*	1.29*
Monthly Use of Materials	49.12	48.74	47.88	47.13	41.95	41.22	38.71	39.50	39.02	38.66	35.51	35.44
Individualization of Instruction	15.91*	15.59*	15.96	15.91	16.15*	16.67*	16.14*	16.63*	16.33	16.53	16.37*	16.07*
Monthly Use of Audio-Visual Equipment	6.68	6.58	6.81	7.48	9.22	9.86	10.08	9.79	8.97	8.50	8.74	8.55
Extent of Ability Grouping	8.67	8.72	8.66	8.72	8.73	8.74	8.74*	8.90*	8.85	8.77	8.72	8.84
Class Size	22.95	23.39	23.56	23.80	23.97	24.55	24.70	24.89	25.13	25.15	26.50	26.40

*Means for the two groups differ significantly at the .01 level.

APPENDIX H

SUPPLEMENTARY TABLES FOR CHAPTER 8

Table H-1

Selected Interaction Terms for Examining the Differential Effects of Instructional Services Received, and Characteristics of Educational Process on Reading Achievement Growth According to Student Characteristics*

Grade	Instructional Services Received and Characteristics of Educational Process	Interactions Between Student Characteristics (Columns)** and Educational Variables (Rows) for Predicting Posttest Scores							
		RACE	FMP	CE75	NEED	MOED	PI	SUMI	CE76
1	Years of Teaching								√√
	Parent/Community Involvement	√√							
	District Control of Instruction				√√				
	Principal's Instructional Leadership				√√				
	Weekly Homework Assigned		√√	√√					
	Monthly Use of Audio-Visual Equipment						√√		
2	Amount of Special Instruction							√√	
	Amount of Tutor/Independent Work	√							
	School's CE Concentration				√√				
	School's Low-Achiever Concentration						√√		
	District's Percent of Administrative Staff						√√		
	Monthly Use of Audio-Visual Equipment		√√						
3	Amount of Special Instruction		√						
	Amount of Tutor/Independent Work		√						
	Staff/Student Ratio				√√				
	Years of Teaching								√√
	Highest Degree Earned						√√		
	School's Low-Achiever Concentration				√√				
4	Amount of Special Instruction			√√					
5	Disturbance of Instruction				√√		√√	√√	
	Effort in Planning and Evaluation								√√
6	Amount of Regular Instruction		√						
	Support/Teaching Personnel Ratio	√√							
	Recent Inservice Training	√√				√√			
	Weekly Homework Assigned						√√		

* Stepwise procedures were employed to select the significant interaction terms after all the main effects have been entered into the regression model first. The main effects include pretest score, 8 student characteristics, 3 kinds of instructional services received, and the education-process variables that were found in the earlier analysis to contribute noticeably to the prediction of reading posttest scores at the particular grade (see Table 6-7). A significant level of .05 was used as the criterion at each of the forward selection and backward elimination steps. The interaction terms selected when the sets of instructional service variables and each of the four sets of selected education-process variables (characteristics of instructional personnel, educational environment, educational practices, and classroom organization) were examined separately are marked with '√' in the table entries. The mark '√√' is used to indicate those interactions retained in the final stepwise analysis that considers all previously selected interaction terms simultaneously. These interactions are then examined for their effects on reading achievement growth.

** RACE: 1 = Caucasian/White, 0 = Minority; FMP: 1 = participation in Free-Meals program, 0 = non-participation; CE75: 1 = Receipt of reading CE in 1975-76, 0 = non-receipt in 75; NEED: 1 = judged to be in need of reading CE by teacher, 0 = not in need; MOED: 1 = mother's educational attainment is high school graduation or more, 0 = less than high school; PI: parental involvement in their own child's education; SUMI: extent of summer intellectual experience in reading (as Summer Activity Slipsheet was not administered to the first graders, this variable is omitted from the analysis for grade 1); CE76: 1 = participating in reading CE in 1976-77, 0 = not participating.

Table H-2

Selected Interaction Terms for Examining the Differential Effects of Instructional Services Received, and Characteristics of Educational Process on Math Achievement Growth According to Student Characteristics*

Grade	Instructional Services Received and Characteristics of Educational Process	Interactions Between Student Characteristics (Columns)** and Educational Variables (Rows) for Predicting Posttest Scores							
		RACE	FMP	CE75	NEED	MOED	PI	SUMI	CE76
1	Amount of Regular Instruction				√√				
	Amount of Tutor/Independent Work			√					
	Years of Teaching	√√							
	Recent Inservice Training								√
	Belief in Schooling								√√
	School's Low-Achiever Concentration								√√
	Teacher's Use of Lesson Plans		√√						
	Weekly Homework Assigned								√
2	Amount of Regular Instruction							√	
	Years of Teaching							√√	
	School's Minority Concentration				√√				
	School's Low-Achiever Concentration		√√						√√
	Parent/Community Involvement								√√
	Weekly Homework Assigned								√√
3	Recent Inservice Training					√√			
	School's Low-Achiever Concentration	√√		√√					
	Frequency of Feedback per Semester							√	
	Monthly Use of Audio-Visual Equipment						√		
4	Amount of Regular Instruction							√√	
	Amount of Tutor/Independent Work	√√							
	Years of Teaching	√√			√√				
	School's CE Concentration			√√	√√	√		√	
	School's Low-Achiever Concentration	√							
	Frequency of Feedback per Semester				√√				
	Individualization of Instruction		√√					√	
	Extent of Ability Grouping	√				√√		√√	
5	Amount of Special Instruction	√							
	Support/Teaching Personnel Ratio		√√						
	Attitude to School Programs								√√
	School's Poverty Concentration				√√				
	School's Low-Achiever Concentration							√√	
6	Years of Teaching	√							
	School's Poverty Concentration	√√					√√		

* Stepwise procedures were employed to select the significant interaction terms after all the main effects have been entered into the regression model first. The main effects include pretest score, 8 student characteristics, 3 kinds of instructional services received, and the education-process variables that were found in the earlier analysis to contribute noticeably to the prediction of math posttest scores at the particular grade (see Table 6-8). A significance level of .05 was used as the criterion at each of the forward selection and backward elimination steps. The interaction terms selected when the set of instructional-service variables and each of the four sets of selected education-process variables (characteristics of instructional personnel, educational environment, educational practices, and classroom organization) were examined separately are marked with '√' in the table entries. The mark '√√' is used to indicate those interactions retained in the final stepwise analysis that considers all previously selected interaction terms simultaneously. These interactions are then examined for their effects on math achievement growth.

** RACE: 1 = Caucasian/White, 0 = Minority; FMP: 1 = participation in Free-Meals program, 0 = non-participation; CE75: 1 = Receipt of math CE in 1975-76, 0 = non-receipt in 75; NEED: 1 = judged to be in need of math CE by teacher, 0 = not in need; MOED: 1 = mother's educational attainment is high school graduation or more, 0 = less than high school; PI: parental involvement in their own child's education; SUMI: extent of summer intellectual experience in math (as Summer Activity Slipsheet was not administered to the first graders, this variable is omitted from the analysis for grade 1); CE76: 1 = participating in math CE in 1976-77, 0 = not participating.

Table H-3

Regression Analyses for Examining the Interaction Effects Between Student Characteristics and Educational Processes on Reading Achievement Growth (Based on the Entire Sample of the First-Year SES Data Base)

Variables Employed in the Multiple Regression Model for the Prediction of Reading Achievement Posttest Score	Unique Contribution to the Squared Multiple Correlation (R^2(U)), and Standardized Regression Coefficient (Beta)											
	Grade 1 N = 10,332		Grade 2 N = 9,672		Grade 3 N = 9,917		Grade 4 N = 10,159		Grade 5 N = 10,088		Grade 6 N = 11,174	
	R^2(U)	Beta	R^2(U)	Beta	R^2(U)	Beta	R^2(U)	Beta	R^2(U)	Beta	R^2(U)	Beta
Student Background Characteristics												
Pretest VSS Score	.176	.510*	.242	.662*	.255	.708*	.330	.787*	.365	.817*	.375	.835*
White/Minority Status (RACE)	.002	.169*	.001	.034*	.000	.013	.001	.041*	.000	.024*	.000	.026*
Free-Meals Participation (FMP)	.001	-.048*	.001	-.036*	.000	-.007	.000	-.023*	.001	-.040*	.000	-.024*
Receipt of CE in 1975-76 (CE75)	.000	-.007	.000	-.011	.000	.006	.000	-.029*	.000	-.018*	.000	-.009
Teacher's Judgment of CE Need (NEED)	.002	-.436*	.004	-.111*	.003	-.188*	.002	-.063*	.000	-.018	.001	-.047*
Mother's Educational Attainment (MOED)	.003	.059*	.001	.035*	.001	.038*	.001	.029*	.000	.024*	.000	.019*
Parental Involvement in Child's Education (PI)	.001	.041*	.000	-.026	.001	.117*	.000	.011	.000	.017	.000	.019*
Summer Intellectual Experience (SUMI)†	NA		.000	-.006	.000	-.009	.000	-.010	.000	-.040*	.000	-.015*
CE Status in 1976-77 (CE76)	.000	-.046*	.000	-.028*	.000	-.029*	.000	-.010	.000	-.042*	.000	-.002
Instructional Services Received												
Regular Instruction	.002	.051*	.001	.039*	.000	.006	.000	.005	.000	.025*	.000	.007
Special Instruction	.001	.030*	.000	-.009	.000	-.014	.000	-.009	.000	.014	.000	-.000
Tutor/Independent Work	.001	.040*	.000	-.009	.000	.004	.000	.013	.000	.010	.000	.008
Characteristics of Educational Process												
Staff/Student Ratio	NA		NA		.000	.013	NA		NA		NA	
Support/Teaching Personnel Ratio	NA		NA		NA		NA		NA		.000	-.029*
Years of Teaching	.003	.064*	.003	.056*	.000	.004	.000	.022*	.000	.022*	NA	
Highest Degree Earned	NA		NA		.000	.030*	NA		NA		NA	
Recent Inservice Training	.000	-.009*	NA		NA		NA		NA		.000	.023*
Attitude to School Programs	NA		.000	-.001	NA		NA		NA		NA	
School's Minority Concentration	NA		NA		NA		.000	.034*	NA		NA	
School's CE Concentration	.002	.069*	.001	.060*	NA		NA		NA		NA	
School's Low-Achiever Concentration	NA		.002	-.100*	.008	-.141*	NA		NA		.000	-.019*
School's Central Resources	.000	.016*	NA		NA		NA		NA		NA	
Parent/Community Involvement	.001	.052*	NA		NA		NA		.000	.013*	NA	
District Control of Instruction	.000	.009*	NA		NA		NA		NA		NA	
Principal's Instructional Leadership	.000	.008	NA		.000	-.019*	NA		NA		NA	
Disturbance of Instruction	.001	.027*	NA		NA		NA		.000	-.022*	NA	
District's Percent of Administrative Staff	NA		.000	-.025*	.000	.015*	NA		NA		NA	
Effort in Planning and Evaluation	NA		NA		NA		NA		.000	.010	NA	
Teacher's Use of Lesson Plans	.000	.010	NA		NA		NA		NA		.000	.008
Frequency of Feedback per Semester	NA		NA		NA		NA		NA		.000	.003
Weekly Homework Assigned	.000	.023	NA		NA		NA		NA		.000	.026*
Monthly Use of Materials	NA		NA		NA		NA		.000	.006	NA	
Individualization of Instruction	NA		NA		NA		NA		.000	-.012*	NA	
Monthly Use of Audio-Visual Equipment	.000	-.007	.000	-.009	NA		NA		.000	-.012	NA	
Classroom Achievement Level	NA		NA		NA		NA		.000	.005	NA	
R^2(R) for the Model Without Interactions	.478 (.692)		.675 (.822)		.737 (.858)		.758 (.871)		.812 (.901)		.821 (.906)	
Interaction Terms*												
Special Instruction x CE75	NA		NA		NA		.000	.015	NA		NA	
Special Instruction x SUMI	NA		.000	-.005	NA		NA		NA		NA	
Staff/Student Ratio x NEED	NA		NA		.000	-.010	NA		NA		NA	
Support/Teaching Personnel Ratio x RACE	NA		NA		NA		NA		NA		.000	.022
Years of Teaching x CE76	.000	-.033	NA		.000	.019	NA		NA		NA	
Highest Degree Earned x PI	NA		NA		.000	-.097*	NA		NA		NA	
Recent Inservice Training x RACE	NA		NA		NA		NA		NA		.000	-.020*
Recent Inservice Training x MOED	NA		NA		NA		NA		NA		.000	.016
School's CE Concentration x NEED	NA		.003	.018	NA		NA		NA		NA	
School's Low-Achiever Concentration x NEED	NA		NA		.003	.138*	NA		NA		NA	
School's Low-Achiever Concentration x PI	NA		.000	.049*	NA		NA		NA		NA	
Parent/Community Involvement x RACE	.002	-.182*	NA		NA		NA		NA		NA	
District Control of Instruction x NEED	.000	.135	NA		NA		NA		NA		NA	
Principal's Instructional Leadership x NEED	.000	.116	NA		NA		NA		NA		NA	
Disturbance of Instruction x NEED	NA		NA		NA		NA		.000	-.034	NA	
Disturbance of Instruction x PI	NA		NA		NA		NA		.000	.002	NA	
Disturbance of Instruction x SUMI	NA		NA		NA		NA		.000	.036*	NA	
District's Percent of Administrative Staff x PI	NA		.000	.016	NA		NA		NA		NA	
Effort in Planning and Evaluation x CE76	NA		NA		NA		NA		.000	.042*	NA	
Weekly Homework Assigned x FMP	.000	.012	NA		NA		NA		NA		NA	
Weekly Homework Assigned x CE75	.000	.024	NA		NA		NA		NA		NA	
Weekly Homework Assigned x PI	NA		NA		NA		NA		NA		.000	-.023*
Monthly Use of Audio-Visual Equipment x FMP	NA		.000	-.014	NA		NA		NA		NA	
Monthly Use of Audio-Visual Equipment x PI	.000	.018	NA		NA		NA		NA		NA	
R^2(R) for the Model with Interactions	.482 (.695)		.676 (.822)		.740 (.860)		.758 (.871)		.813 (.901)		.821 (.906)	
F Statistics for the Contribution of Interactions	11.51**		3.76**		29.31**		2.98		5.01**		6.12**	

† The variable Summer Intellectual Experience was not available for grade 1, and therefore not used in the analysis for that grade.

* See Table H-1 for an explanation of the selection of interaction terms to be included in the present regression analyses. The starred entries in the Beta column indicate that the regression coefficients are significantly different from zero at the .01 level.

** The partial contribution of the combined interaction terms to the posttest-score variance is significant at the .01 level. The degrees of freedom are number of interaction terms for the numerator, and N-1 minus number of predictors in the model (main effects and interactions) for the denominator.

Note — Any negative coefficients for 'CE Status in 1976-77' should not be carelessly interpreted as harmful effects of CE. In the present context, this coefficient can be more properly viewed as a reflection of the achievement differences attributable to other unmeasured student characteristics that are correlated with CE Status (see Chapter 3 for more explanation).

Table H-4

Regression Analyses for Examining the Interaction Effects Between Student Characteristics and Educational Processes on Reading Achievement Growth (Based on a 15 Percent Random Sample from Each Grade)

Variables Employed in the Multiple Regression Model for the Prediction of Reading Achievement Posttest Score	Unique Contribution to the Squared Multiple Correlation (R^2(U)), and Standardized Regression Coefficient (Beta)											
	Grade 1 N = 1,478		Grade 2 N = 1,414		Grade 3 N = 1,463		Grade 4 N = 1,481		Grade 5 N = 1,457		Grade 6 N = 1,618	
	R^2 (U)	Beta	R^2 (U)	Beta	R^2 (U)	Beta	R^2 (U)	Beta	R^2 (U)	Beta	R^2 (U)	Beta
Student Background Characteristics												
Pretest VSS Score	.169	.508*	.232	.642*	.234	.684*	.348	.791*	.350	.811*	.341	.806*
White/Minority Status (RACE)	.002	.173	.002	.049	.000	.017	.001	.060*	.000	.022	.000	.021
Free-Meals Participation (FMP)	.004	-.089*	.000	-.018	.000	-.019	.000	-.017	.002	-.060*	.000	.002
Receipt of CE in 1975-76 (CE75)	.001	-.042	.001	-.033	.001	.031	.001	-.050	.000	-.010	.000	-.004
Teacher's Judgment of CE Need (NEED)	.000	-.115	.013	-.198*	.006	-.314*	.002	-.060*	.000	.054	.003	-.074*
Mother's Educational Attainment (MOED)	.002	.055*	.001	.043	.007	.047*	.001	.033	.000	.021	.000	.017
Parental Involvement in Child's Education (PI)	.000	-.000	.002	-.122*	.001	.187*	.000	-.002	.001	.120*	.001	.041*
Summer Intellectual Experience (SUMI)[†]	NA		.000	-.029	.000	.002	.000	-.005	.002	-.141*	.001	-.023
CE Status in 1976-77 (CE76)	.000	-.019	.000	.022	.003	-.122*	.000	-.001	.002	-.138*	.000	-.010
Instructional Services Received												
Regular Instruction	.002	.052	.001	.031	.000	-.004	.000	.003	.000	.006	.000	.005
Special Instruction	.000	.027	.000	-.033	.000	-.028	.001	-.041	.000	-.010	.000	-.008
Tutor/Independent Work	.001	.027	.000	.006	.000	.003	.000	.003	.000	.012	.000	.025
Characteristics of Educational Process												
Staff/Student Ratio	NA		NA		.000	.018	NA		NA		NA	
Support/Teaching Personnel Ratio	NA		NA		NA		NA		NA		.001	-.063
Years of Teaching	.006	.086*	.002	.044*	.000	-.003	.001	.031	.001	.032*	NA	
Highest Degree Earned	NA		NA		.002	.063*	NA		NA		NA	
Recent Inservice Training	.001	.030	NA		NA		NA		NA		.000	.031
Attitude to School Programs	NA		.001	-.037	NA		NA		NA		NA	
School's Minority Concentration	NA		NA		NA		.001	.037	NA		NA	
School's CE Concentration	.005	.103*	.000	-.007	NA		NA		NA		NA	
School's Low-Achiever Concentration	NA		.003	-.105*	.009	-.151*	NA		NA		.001	-.049*
School's Central Resources	.000	.014	NA		NA		NA		NA		NA	
Parent/Community Involvement	.000	-.006	NA		NA		NA		.001	.031*	NA	
District Control of Instruction	.002	.049	NA		NA		NA		NA		NA	
Principal's Instructional Leadership	.001	.035	NA		.001	-.027	NA		NA		NA	
Disturbance of Instruction	.002	.052	NA		NA		NA		.000	-.016	NA	
District's Percent of Administrative Staff	NA		.002	-.069*	.001	.030	NA		NA		NA	
Effort in Planning and Evaluation	NA		NA		NA		NA		.000	.010	NA	
Teacher's Use of Lesson Plans	.001	.041	NA		NA		NA		NA		.001	.029*
Frequency of Feedback per Semester	NA		NA		NA		NA		NA		.001	.025
Weekly Homework Assigned	.000	-.015	NA		NA		NA		NA		.001	.057*
Monthly Use of Materials	NA		NA		NA		NA		.000	.017	NA	
Individualization of Instruction	NA		NA		NA		NA		.001	-.030	NA	
Monthly Use of Audio-Visual Equipment	.000	-.019	.000	.001	NA		NA		.000	-.022	NA	
Classroom Achievement Level	NA		NA		NA		NA		.001	.031*	NA	
R^2(R) for the Model Without Interactions	.518 (.719)		.674 (.821)		.743 (.862)		.768 (.876)		.815 (.903)		.821 (.906)	
Interaction Terms[*]												
Special Instruction x CE75	NA		NA		NA		.001	.060	NA		NA	
Special Instruction x SUMI	NA		.001	.052	NA		NA		NA		NA	
Staff/Student Ratio x NEED	NA		NA		.001	.099	NA		NA		NA	
Support/Teaching Personnel Ratio x RACE	NA		NA		NA		NA		NA		.000	.063
Years of Teaching x CE76	.002	-.086	NA		.001	.064	NA		NA		NA	
Highest Degree Earned x PI	NA		NA		.001	-.162	NA		NA		NA	
Recent Inservice Training x RACE	NA		NA		NA		NA		NA		.001	-.050*
Recent Inservice Training x MOED	NA		NA		NA		NA		NA		.001	.047
School's CE Concentration x NEED	NA		.003	.101*	NA		NA		NA		NA	
School's Low-Achiever Concentration x NEED	NA		NA		.004	.183*	NA		NA		NA	
School's Low-Achiever Concentration x PI	NA		.001	.079	NA		NA		NA		NA	
Parent/Community Involvement x RACE	.003	-.190*	NA		NA		NA		NA		NA	
District Control of Instruction x NEED	.002	-.357	NA		NA		NA		NA		NA	
Principal's Instructional Leadership x NEED	.001	.276	NA		NA		NA		NA		NA	
Disturbance of Instruction x NEED	NA		NA		NA		NA		.001	-.087	NA	
Disturbance of Instruction x PI	NA		NA		NA		NA		.001	-.117*	NA	
Disturbance of Instruction x SUMI	NA		NA		NA		NA		.002	.158*	NA	
District's Percent of Administrative Staff x PI	NA		.001	.087	NA		NA		NA		NA	
Effort in Planning and Evaluation x CE76	NA		NA		NA		NA		.002	.136*	NA	
Weekly Homework Assigned x FMP	.001	.059	NA		NA		NA		NA		NA	
Weekly Homework Assigned x CE75	.002	.056	NA		NA		NA		NA		NA	
Weekly Homework Assigned x PI	NA		NA		NA		NA		NA		.001	-.056
Monthly Use of Audio-Visual Equipment x FMP	NA		.001	-.058	NA		NA		NA		NA	
Monthly Use of Audio-Visual Equipment x PI	.002	.093	NA		NA		NA		NA		NA	
R^2(R) for the Model with Interactions	.531 (.729)		.681 (.825)		.750 (.866)		.769 (.877)		.820 (.906)		.824 (.908)	
F Statistics for the Contribution of Interactions	5.87**		6.39**		10.64**		6.43		10.40**		5.77**	

[†] The variable Summer Intellectual Experience was not available for grade 1, and therefore not used in the analysis for that grade.

[*] See Table H-1 for an explanation of the selection of interaction terms to be included in the present regression analyses. The starred entries in the Beta column indicate that the regression coefficients are significantly different from zero at the .01 level.

[**] The partial contribution of the combined interaction terms to the posttest-score variance is significant at the .01 level. The degrees of freedom are number of interaction terms for the numerator, and N-1 minus number of predictors in the model (main effects and interactions) for the denominator.

Note — Any negative coefficients for 'CE Status in 1976-77' should not be carelessly interpreted as harmful effects of CE. In the present context, this coefficient can be more properly viewed as a reflection of the achievement differences attributable to other unmeasured student characteristics that are correlated with CE Status (see Chapter 3 for more explanation).

Table H-5

Regression Analyses for Examining the Interaction Effects Between Student Characteristics and Educational Processes on Math Achievement Growth (Based on the Entire Sample of the First-Year SES Data Base)

Variables Employed in the Multiple Regression Model for the Prediction of Math Achievement Posttest Score	Unique Contribution to the Squared Multiple Correlation (R^2(U)), and Standardized Regression Coefficient (Beta)											
	Grade 1 N = 10,202		Grade 2 N = 9,226		Grade 3 N = 9,218		Grade 4 N = 8,961		Grade 5 N = 10,406		Grade 6 N = 10,940	
	R^2(U)	Beta	R^2(U)	Beta	R^2(U)	Beta	R^2(U)	Beta	R^2(U)	Beta	R^2(U)	Beta
Student Background Characteristics												
Pretest VSS Score	.227	.557*	.264	.606*	.216	.561*	.285	.675*	.307	.695*	.387	.750*
White/Minority Status (RACE)	.000	.039*	.002	.068*	.003	.183*	.000	.043	.000	.016	.001	.051*
Free-Meals Participation (FMP)	.001	-.120*	.001	-.095*	.000	-.017	.000	.077	.000	-.016	.000	-.024*
Receipt of CE in 1975-76 (CE75)	.001	.044*	.000	.013	.001	-.107*	.000	.003	.000	-.020*	.000	.001
Teacher's Judgment of CE Need (NEED)	.008	-.195*	.006	-.131*	.011	-.134*	.005	-.199*	.003	-.127*	.004	-.080*
Mother's Educational Attainment (MOED)	.001	.033*	.001	.042*	.001	.034*	.000	-.040	.000	.013	.001	.031*
Parental Involvement in Child's Education (PI)	.001	.040*	.000	.021*	.000	.007	.000	.008	.000	.021*	.000	.037*
Summer Intellectual Experience (SUMI)†	NA		.000	-.012	.001	-.038*	.000	.035	.000	-.030	.000	-.012
CE Status in 1976-77 (CE76)	.000	-.035	.000	-.016	.000	.016	.000	-.024*	.000	.041	.000	.008
Instructional Services Received												
Regular Instruction	.000	.022	.002	.055*	.003	.071*	.002	.057*	.002	.067*	.001	.049*
Special Instruction	.000	.018	.000	.005	.000	.011	.003	.068*	.000	.028*	.000	.015
Tutor/Independent Work	.001	.036*	.000	-.013	.001	.033*	.002	.107*	.001	.047*	.000	.026*
Characteristics of Educational Process												
Support/Teaching Personnel Ratio	NA		NA		NA		NA		.000	.016	.001	-.027*
Years of Teaching	.001	.069*	.004	.070*	NA		.000	-.050*	.001	.027*	.000	.020*
Recent Inservice Training	.000	-.013	NA		.000	-.023	.000	.008	NA		NA	
Belief in Schooling	.001	.036*	NA		NA		NA		NA		.000	-.020*
Attitude to School Programs	NA		NA		NA		NA		.000	.019*	NA	
School's Minority Concentration	NA		.001	.068*	.000	.034	.001	.068*	NA		NA	
School's Poverty Concentration	NA		NA		NA		NA		.000	.036*	.000	.032*
School's CE Concentration	NA		NA		NA		.000	-.034*	NA		NA	
School's Low-Achiever Concentration	.002	-.055*	.002	-.078*	.003	-.142*	.004	-.102*	.004	-.110*	NA	
School's Central Resources	.000	.022*	NA		NA		NA		NA		NA	
Parent/Community Involvement	NA		.000	-.004	NA		NA		.001	.028*	NA	
Principal's Instructional Leadership	NA		NA		NA		.000	-.013	NA		NA	
Teacher's Involvement in Decisions	NA		.000	.006	NA		NA		.000	-.011	NA	
Disturbance of Instruction	NA		NA		NA		NA		.001	-.038*	NA	
District's Testing Program	NA		NA		.000	-.012	NA		NA		NA	
District's Percent of Administrative Staff	NA		NA		.001	.034*	NA		NA		NA	
Effort in Curriculum Development	NA		NA		NA		NA		.000	-.007	.000	-.009
Teacher's Use of Lesson Plans	.000	-.028*	NA		NA		NA		.000	.023*	NA	
Frequency of Feedback per Semester	NA		NA		.001	.023*	.000	.003	NA		.001	.032*
Weekly Homework Assigned	.001	.028*	.000	.012	NA		.000	.023*	NA		.001	.033*
Monthly Use of Materials	NA		.001	.033*	NA		NA		NA		NA	
Individualization of Instruction	NA		NA		.001	-.032*	.000	-.012	NA		.001	.038*
Monthly Use of Audio-Visual Equipment	NA		NA		.000	.013	NA		NA		.000	-.015
Extent of Ability Grouping	NA		NA		NA		.000	-.035*	NA		NA	
Class Size	NA		.000	-.007	.000	.004	NA		NA		NA	
R^2(R) for the Model Without Interactions	.468 (.684)		.544 (.738)		.594 (.771)		.632 (.795)		.668 (.817)		.684 (.827)	
Interaction Terms*												
Regular Instruction x NEED	.000	.029	NA		NA		NA		NA		NA	
Regular Instruction x SUMI	NA		NA		NA		.000	-.010	NA		NA	
Tutor/Independent Work x RACE	NA		NA		NA		.001	-.099*	NA		NA	
Support/Teaching Personnel Ratio x FMP	NA		NA		NA		NA		.000	-.041*	NA	
Years of Teaching x RACE	.001	-.064*	NA		NA		.001	.071*	NA		NA	
Years of Teaching x NEED	NA		NA		NA		.001	.051*	NA		NA	
Years of Teaching x SUMI	NA		.000	-.013	NA		NA		NA		NA	
Recent Inservice Training x MOED	NA		NA		.000	-.009	NA		NA		NA	
Belief in Schooling x CE76	.000	-.073	NA		NA		NA		NA		NA	
Attitude to School Programs x CE76	NA		NA		NA		NA		.000	-.048	NA	
School's Minority Concentration x NEED	NA		.000	-.006	NA		NA		NA		NA	
Schools' Poverty Concentration x RACE	NA		NA		NA		NA		NA		.000	-.023
School's Poverty Concentration x NEED	NA		NA		NA		NA		.001	.068*	NA	
School's Poverty Concentration x PI	NA		NA		NA		NA		NA		.000	-.038*
Schools' CE Concentration x CE75	NA		NA		NA		.001	-.064*	NA		NA	
School's CE Concentration x NEED	NA		NA		NA		.003	.092*	NA		NA	
School's Low-Achiever Concentration x RACE	NA		NA		.003	-.165*	NA		NA		NA	
School's Low-Achiever Concentration x FMP	NA		.001	.098*	NA		NA		NA		NA	
School's Low-Achiever Concentration x CE75	NA		NA		.001	.117*	NA		NA		NA	
School's Low-Achiever Concentration x SUMI	NA		NA		NA		NA		.000	.015	NA	
School's Low-Achiever Concentration x CE76	.001	.122*	.000	-.078*	NA		NA		NA		NA	
Parent/Community Involvement x CE76	NA		.000	.068*	NA		NA		NA		NA	
Teacher's Use of Lesson Plans x FMP	.000	.104*	NA		NA		NA		NA		NA	
Frequency of Feedback per Semester x NEED	NA		NA		NA		.000	.027	NA		NA	
Weekly Homework Assigned x CE76	NA		.000	.024	NA		NA		NA		NA	
Individualization of Instruction x FMP	NA		NA		NA		.000	-.088	NA		NA	
Extent of Ability Grouping x MOED	NA		NA		NA		.000	.082	NA		NA	
Extent of Ability Grouping x SUMI	NA		NA		NA		.000	-.052	NA		NA	
R^2 (R) for the Model with Interactions	.471 (.686)		.546 (.739)		.599 (.774)		.639 (.799)		.670 (.818)		.685 (.827)	
F Statistics for the Contribution of Interactions	10.42**		4.44**		41.07**		16.03**		12.67**		9.82**	

† The variable Summer Intellectual Experience was not available for grade 1, and therefore not used in the analysis for that grade.

* See Table H-2 for an explanation of the selection of interaction terms to be included in the present regression analyses. The starred entries in the Beta column indicate that the regression coefficients are significantly different from zero at the .01 level.

** The partial contribution of the combined interaction terms to the posttest-score variance is significant at the .01 level. The degrees of freedom are number of interaction terms for the numerator, and N-1 minus number of predictors in the model (main effects and interactions) for the denominator.

Note — See Table H-3 for the meaning of the coefficient for 'CE Status in 1976-77'.

Table H-6

Regression Analyses for Examining the Interaction Effects Between Student Characteristics and Educational Processes on Math Achievement Growth (Based on a 15 percent Random Sample from Each Grade)

Variables Employed in the Multiple Regression Model for the Prediction of Math Achievement Posttest Score	Unique Contribution to the Squared Multiple Correlation (R^2(U)), and Standardized Regression Coefficient (Beta)											
	Grade 1 N = 1,457		Grade 2 N = 1,354		Grade 3 N = 1,357		Grade 4 N = 1,303		Grade 5 N = 1,506		Grade 6 N = 1,550	
	R^2 (U)	Beta	R^2 (U)	Beta	R^2 (U)	Beta	R^2 (U)	Beta	R^2 (U)	Beta	R^2 (U)	Beta
Student Background Characteristics												
Pretest VSS Score	.224	.560*	.283	.633*	.233	.583*	.271	.659*	.313	.710*	.358	.743*
White/Minority Status (RACE)	.001	.050	.001	.052	.002	.160*	.000	.036	.000	.020	.003	.120*
Free-Meals Participation (FMP)	.002	.268*	.002	-.131	.060	-.010	.001	.165	.000	.030	.001	-.035
Receipt of CE in 1975-76 (CE75)	.000	.011	.001	.044	.001	-.099	.002	.066	.000	-.005	.000	-.017
Teacher's Judgment of CE Need (NEED)	.011	-.225*	.003	-.091*	.011	-.141*	.010	-.298*	.005	-.156*	.002	-.064*
Mother's Educational Attainment (MOED)	.001	.041	.002	.045	.001	-.049	.002	-.297*	.000	.023	.003	.056*
Parental Involvement in Child's Education (PI)	.001	.025	.001	.025	.000	.018	.000	-.004	.001	.025	.001	.047
Summer Intellectual Experience (SUMI)[†]	NA		.002	-.077	.002	-.049*	.002	.295*	.001	.066	.001	-.031
CE Status in 1976-77 (CE76)	.001	-.105	.000	-.008	.001	-.030	.000	-.012	.001	.107	.001	-.041
Instructional Services Received												
Regular Instruction	.000	.004	.002	.053*	.005	.087*	.003	.077*	.002	.064*	.000	.014
Special Instruction	.000	.008	.000	-.012	.001	.045	.003	.070*	.000	.026	.000	.004
Tutor/Independent Work	.000	.014	.000	-.002	.002	.048*	.004	.130*	.001	.047	.000	.010
Characteristics of Educational Process												
Support/Teaching Personnel Ratio	NA		NA		NA		NA		.002	.055*	.001	-.031
Years of Teaching	.003	.101*	.005	.079*	NA		.000	-.032	.001	.028	.002	.048*
Recent Inservice Training	.000	.023	NA		.004	-.133*	.001	.026	NA		NA	
Belief in Schooling	.003	.057*	NA		NA		NA		NA		.003	-.054*
Attitude to School Programs	NA		NA		NA		NA		.001	.039	NA	
School's Minority Concentration	NA		.001	.061	.000	.037	.003	.099*	NA		NA	
School's Poverty Concentration	NA		NA		NA		NA		.000	.008	.003	.135*
School's CE Concentration	NA		NA		NA		.000	-.021	NA		NA	
School's Low-Achiever Concentration	.005	-.098*	.001	-.060	.004	-.178*	.005	-.114*	.002	-.077*	NA	
School's Central Resources	.001	.038	NA		NA		NA		NA		NA	
Parent/Community Involvement	NA		.000	.027	NA		NA		.001	.038	NA	
Principal's Instructional Leadership	NA		NA		NA		.001	-.033	NA		NA	
Teacher's Involvement in Decisions	NA		.000	-.020	NA		NA		.000	-.019	NA	
Disturbance of Instruction	NA		NA		NA		NA		.001	-.036	NA	
District's Testing Program	NA		NA		.001	-.033	NA		NA		NA	
District's Percent of Administrative Staff	NA		NA		.003	.059*	NA		NA		NA	
Effort in Curriculum Development	NA		NA		NA		NA		.002	-.049*	.000	-.019
Teacher's Use of Lesson Plans	.002	-.064*	NA		NA		NA		.001	.026	NA	
Frequency of Feedback per Semester	NA		NA		.000	.014	.000	.004	NA		.001	.025
Weekly Homework Assigned	.002	.043	.000	-.016	NA		.004	.063*	NA		.001	.034
Monthly Use of Materials	NA		.002	.051*	NA		NA		NA		NA	
Individualization of Instruction	NA		NA		.002	-.043	.000	.003	NA		.003	.063*
Monthly Use of Audio-Visual Equipment	NA		NA		.001	.033	NA		NA		.001	-.028
Extent of Ability Grouping	NA		NA		NA		.004	-.130*	NA		NA	
Class Size	NA		.001	-.029	.000	-.024	NA		NA		NA	
R^2 (R) for the Model Without Interactions	.486 (.697)		.566 (.753)		.636 (.797)		.630 (.794)		.678 (.823)		.702 (.838)	
Interaction Terms[*]												
Regular Instruction x NEED	.003	.103*	NA		NA		NA		NA		NA	
Regular Instruction x SUMI	NA		NA		NA		.001	-.089	NA		NA	
Tutor/Independent Work x RACE	NA		NA		NA		.002	-.116*	NA		NA	
Support/Teaching Personnel Ratio x FMP	NA		NA		NA		NA		.003	-.097*	NA	
Years of Teaching x RACE	.002	-.110	NA		NA		.001	.097	NA		NA	
Years of Teaching x NEED	NA		NA		NA		.002	.091*	NA		NA	
Years of Teaching x SUMI	NA		.003	.099*	NA		NA		NA		NA	
Recent Inservice Training x MOED	NA		NA		.003	.128*	NA		NA		NA	
Belief in Schooling x CE76	.002	-.190*	NA		NA		NA		NA		NA	
Attitude to School Programs x CE76	NA		NA		NA		NA		.001	-.116	NA	
School's Minority Concentration x NEED	NA		.002	-.084*	NA		NA		NA		NA	
School's Poverty Concentration x RACE	NA		NA		NA		NA		NA		.002	-.075*
School's Poverty Concentration x NEED	NA		NA		NA		NA		.003	.139*	NA	
School's Poverty Concentration x PI	NA		NA		NA		NA		NA		.001	-.056
School's CE Concentration x CE75	NA		NA		NA		.010	-.188*	NA		NA	
School's CE Concentration x NEED	NA		NA		NA		.004	.108*	NA		NA	
School's Low-Achiever Concentration x RACE	NA		NA		.003	-.164*	NA		NA		NA	
School's Low-Achiever Concentration x FMP	NA		.002	.177	NA		NA		NA		NA	
School's Low-Achiever Concentration x CE75	NA		NA		.002	.147*	NA		NA		NA	
School's Low-Achiever Concentration x SUMI	NA		NA		NA		NA		.001	-.104	NA	
School's Low-Achiever Concentration x CE76	.008	.286*	.003	-.214*	NA		NA		NA		NA	
Parent/Community Involvement x CE76	NA		.002	.152	NA		NA		NA		NA	
Teacher's Use of Lesson Plans x FMP	.002	.237	NA		NA		NA		NA		NA	
Frequency of Feedback per Semester x NEED	NA		NA		NA		.002	.110*	NA		NA	
Weekly Homework Assigned x CE76	NA		.002	.066*	NA		NA		NA		NA	
Individualization of Instruction x FMP	NA		NA		NA		.001	-.214	NA		NA	
Extent of Ability Grouping x MOED	NA		NA		NA		.003	.361*	NA		NA	
Extent of Ability Grouping x SUMI	NA		NA		NA		.001	-.227	NA		NA	
R^2 (R) for the Model with Interactions	.501 (.707)		.578 (.760)		.645 (.803)		.657 (.811)		.686 (.828)		.705 (.840)	
F Statistics for the Contribution of Interactions	8.40**		6.26**		11.33**		9.84**		9.66**		6.71**	

[†] The variable Summer Intellectual Experience was not available for grade 1, and therefore not used in the analysis for that grade.

[*] See Table H-2 for an explanation of the selection of interaction terms to be included in the present regression analyses. The starred entries in the Beta column indicate that the regression coefficients are significantly different from zero at the .01 level.

[**] The partial contribution of the combined interaction terms to the posttest-score variance is significant at the .01 level. The degrees of freedom are number of interaction terms for the numerator, and N-1 minus number of predictors in the model (main effects and interactions) for the denominator.

Note — See Table H-3 for the meaning of the coefficient for 'CE Status in 1976-77'.

Table H-7

Means and Standard Deviations (S.D.) of Fall-to-Spring Gains for Non-CE Students Judged as Needing CE and Attended Schools Where CE in the Subject Area Was Not Provided*

Grade	VSS Gain		Z-Score Gain	
	Mean	S.D.	Mean	S.D.
Reading				
1	52.79	36.70	-.113	.864
2	38.41	36.95	-.046	.677
3	29.48	37.16	-.030	.633
4	30.25	34.95	.012	.546
5	22.60	36.48	-.020	.502
6	25.14	36.15	.010	.481
Math				
1	49.13	35.91	-.145	.825
2	46.74	40.26	-.058	.791
3	50.11	42.66	-.037	.771
4	46.97	45.30	-.003	.679
5	35.75	45.34	-.008	.622
6	33.73	47.66	-.036	.601

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*The z-score gains were the differences between fall and spring achievement scores measured in terms of standardized normal deivates (z). These data were used to assign CE students to growth groups. Those achieved gains one s.d. greater and smaller than the corresponding means in both types of gain scores were assigned to the 'high' and 'low' growth groups, respectively. The rest of the CE students were assigned to the 'comparable' growth group.

Table H-8

Percentage of CE Students Whose Fall-to-Spring Growth is High, Comparable, or Low in Comparison with the Average for Non-CE Students Judged to Have Need for CE But Attending Schools That Do Not Provide CE in the Subject Area*

GRADE	Fall-to-Spring Growth Relative to the Average for the Needy Non-CE Students in Non-CE Schools*	Subgroups of CE Students						Total	
		Title I Students in Title I Schools		Other-CE Students in Title I Schools		CE Students in Other-CE Schools			
		N	%	N	%	N	%	N	%
	Reading Achievement**								
1	High	444	15.9	139	14.1	71	12.4	654	15.1
	Comparable	2,090	75.0	765	77.5	434	75.6	3,289	75.7
	Low	251	9.0	83	8.4	69	12.0	403	9.3
	Total	2,785	99.9	987	100.0	574	100.0	4,346	100.1
2	High	437	14.4	122	12.9	119	16.9	678	14.5
	Comparable	2,325	76.6	729	76.9	528	75.0	3,582	76.4
	Low	274	9.0	97	10.2	57	8.1	428	9.1
	Total	3,036	100.0	948	100.0	704	100.0	4,688	100.0
3	High	374	12.4	81	9.2	96	15.3	551	12.2
	Comparable	2,439	80.7	711	80.4	479	76.2	3,629	80.0
	Low	209	6.9	92	10.4	54	8.6	355	7.8
	Total	3,022	100.0	884	100.0	629	100.1	4,535	100.0
4	High	349	14.6	91	10.5	89	14.4	529	13.7
	Comparable	1,703	71.2	660	76.4	431	69.6	2,794	72.1
	Low	340	14.2	113	13.1	99	16.0	552	14.3
	Total	2,392	100.0	864	100.0	619	100.0	3,875	100.1
5	High	279	12.5	65	8.1	86	14.7	430	11.9
	Comparable	1,710	76.8	659	82.2	440	75.0	2,809	77.7
	Low	238	10.7	78	9.7	61	10.4	377	10.4
	Total	2,227	100.0	802	100.0	587	100.1	3,616	100.0
6	High	231	11.7	97	10.7	47	7.6	375	10.7
	Comparable	1,529	77.1	718	79.3	489	78.9	2,736	78.0
	Low	222	11.2	90	9.9	84	13.6	396	11.3
	Total	1,982	100.0	905	99.9	620	100.1	3,507	100.0
	Math Achievement**								
1	High	355	22.2	143	16.7	74	22.5	572	20.6
	Comparable	1,119	70.0	627	73.3	225	68.4	1,971	70.9
	Low	124	7.8	85	9.9	30	9.1	239	8.6
	Total	1,598	100.0	855	99.9	329	100.0	2,782	100.1
2	High	282	16.7	116	14.4	52	17.9	450	16.2
	Comparable	1,245	73.8	627	77.6	211	72.5	2,083	74.8
	Low	159	9.4	65	8.0	28	9.6	252	9.1
	Total	1,686	99.9	808	100.0	291	100.0	2,785	100.1
3	High	269	15.0	86	11.2	34	9.2	389	13.3
	Comparable	1,381	77.0	580	75.5	281	76.2	2,242	76.5
	Low	143	8.0	102	13.3	54	14.6	299	10.2
	Total	1,793	100.0	768	100.0	369	100.0	2,930	100.0
4	High	219	15.3	95	11.2	34	9.1	348	13.1
	Comparable	1,094	76.3	646	76.5	269	72.1	2,009	75.8
	Low	121	8.4	104	12.3	70	18.8	295	11.1
	Total	1,434	100.0	845	100.0	373	100.0	2,652	100.0
5	High	220	16.5	93	12.1	57	14.3	370	14.8
	Comparable	1,004	75.4	576	75.0	307	76.8	1,887	75.5
	Low	107	8.0	99	12.9	36	9.0	242	9.7
	Total	1,331	99.9	768	100.0	400	100.1	2,499	100.0
6	High	206	18.2	130	15.2	58	12.7	394	16.1
	Comparable	831	73.3	653	76.1	350	76.6	1,834	74.9
	Low	97	8.6	75	8.7	49	10.7	221	9.0
	Total	1,134	100.1	858	100.0	457	100.0	2,449	100.0

*High = at least one s.d. above the average, Comparable = within ± one s.d. of the average, and Low = at least one s.d. below the average.

**Chi-square statistics show significant association between CE categories and growth groups at the .01 level for grades 3 and 5 in reading, and grades 3, 4, and 5 in math.

Table H-9

Means of the Potential Discriminating Variables Employed in the Discriminant Analysis for the Two Groups of Reading CE Students Whose Fall-to-Spring Achievement Growth is at Least One Standard Deviation Higher or Lower Than the Average for the Non-CE Students Judged to Have Need for CE But Attending Schools That Do Not Provide Reading CE

Potential Discriminating Variables	Means for Reading CE Students with 'High' and 'Low' Achievement Growth											
	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	High	Low	High	Low	High	Low	high	Low	High	Low	High	Low
N =	564	330	559	359	501	293	475	475	362	301	298	304
Student Characteristics												
Pretest Achievement Quartile	1.57*	2.25*	1.36*	2.02*	1.29*	2.04*	1.23*	1.49*	1.22*	1.41*	1.19*	1.41*
Participation in Title I Programs	.68*	.59*	.63	.64	.69*	.60*	.65	.64	.67	.61	.67	.61
Instructional Services Received Per Year												
Regular Instruction	123.09*	104.47*	105.01	100.28	86.93	86.45	78.93	79.66	82.60	78.61	83.39	78.31
Special Instruction	100.74	105.09	96.79	105.55	102.65	99.39	87.50	86.63	78.99	74.89	76.21	71.46
Tutor/Independent Work	90.32	82.15	87.63	82.33	82.37	75.18	69.33	71.80	64.85	65.68	64.34	56.14
Characteristics of Educational Process												
Staff/Student Ratio	.07	.07	.07*	.08*	.07	.07	.07	.07	.07	.08	.08	.08
Support/Teaching Personnel Ratio	.13*	.15*	.13*	.15*	.14	.14	.15	.15	.13*	.15*	.15	.16
Year of Teaching	10.57	9.88	11.87*	10.64*	10.82	9.84	12.70	11.76	11.14	10.54	12.31	10.97
Highest Degree Earned	2.58	2.52	2.59	2.58	2.60	2.56	2.75	2.71	2.67	2.62	2.72	2.66
Recent Inservice Training	18.05*	11.30*	15.02	17.39	13.46	12.74	17.17	16.21	14.70	13.48	18.53	15.79
Attitude to School Programs	11.66	11.44	11.53	11.55	11.33	11.31	11.00	10.65	10.62	10.68	10.10	10.26
Schools' Minority Concentration	61.77*	41.11*	44.86	50.62	49.54	45.81	54.07	53.55	49.81	48.74	64.43	58.85
School's CE Concentration	61.55*	42.22*	46.91	49.16	48.02	47.25	48.56	48.11	41.40	44.30	50.40	45.88
School's Low-Achiever Concentration	53.05*	44.79*	45.59	47.79	48.71	47.20	50.88	52.29	47.27	49.13	55.09	53.43
School's Central Resources	.83*	.67*	.71	.69	.79	.74	.81*	.74*	.75	.68	.77	.69
Parent/Community Involvement	54.11*	48.26*	49.72	50.04	50.54	50.50	50.07	48.44	48.29	47.28	49.50	47.84
District Control of Instruction	43.03	42.11	42.57*	41.52*	42.03	41.46	41.18	41.81	42.01	41.53	41.92	42.42
Principal's Instructional Leadership	56.46*	54.44*	54.84	54.65	54.71	55.68	53.99	54.54	54.49	54.50	54.52	54.80
Disturbance of Instruction	59.68*	55.75*	55.24	58.11	55.38	57.14	55.03*	58.57*	55.50*	61.09*	61.97	61.74
District's Percent of Administrative Staff	5.04	5.01	4.91*	5.80*	5.02	5.15	4.96*	5.50*	4.96	5.03	5.62	5.52
Effort in Planning and Evaluation	23.95*	21.38*	24.17	23.89	22.86	21.59	24.06	23.70	23.49*	21.92*	23.07*	21.51*
Teacher's Use of Lesson Plans	.92	.95	.88	.90	.85	.86	.92*	.86*	.94	.90	.97	.93
Frequency of Feedback per Semester	121.71	115.75	118.63	111.34	120.10	118.58	110.12	110.93	95.63	96.00	89.60	92.38
Weekly Homework Assigned	.70*	.50*	.64	.62	.53	.56	.64	.70	.73	.63	.72	.77
Monthly Use of Materials	79.97*	72.99*	76.20	78.63	68.07	66.62	63.62	64.55	63.57	66.75	60.11	60.63
Individualization of Instruction	20.65	20.40	21.06	20.93	21.93	21.62	21.72	21.97	21.70	21.77	22.00	21.98
Monthly Use of Audio-Visual Equipment	30.34*	22.84*	26.54	26.02	29.96*	22.24*	29.65	29.24	26.41	24.86	29.15	28.59
Classroom Achievement Level	.65	.58	.53	.49	.60	.52	.54	.55	.43	.46	.45	.42

*Means for the two groups differ significantly at the .01 level.

Note - The differences in N's between this table and Table H-8 are due to missing data for the educational variables.

Table H-10

Means of the Potential Discriminating Variables Employed in the Discriminant Analysis for the Two Groups of Math CE Students Whose Fall-to-Spring Achievement Growth is at Least One Standard Deviation Higher or Lower Than the Average for the Non-CE Students Judged to Have Need for CE But Attending Schools That Do Not Provide Math CE

Potential Discriminating Variables	Means for Math CE Students with 'High' and 'Low' Achievement Growth											
	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
N =	485	193	371	205	329	230	308	240	309	185	339	180
Student Characteristics												
Pretest Achievement Quartile	1.64*	2.54*	1.39*	2.16*	1.33*	2.38*	1.39*	2.14*	1.28*	1.90*	1.35*	1.94*
Participation in Title I Programs	.63*	.52*	.63	.65	.70*	.50*	.63*	.43*	.60*	.47*	.51	.42
Instructional Services Received per Year												
Regular Instruction	74.60	76.82	81.88	76.45	83.22	82.90	84.82	92.06	88.78	81.34	79.83	71.92
Special Instruction	50.21*	41.11*	43.54	42.36	53.32	50.82	61.16*	41.40*	56.81	64.69	49.69	48.45
Tutor/Independent Work	54.96*	46.26*	54.37	51.67	53.09	60.37	59.35	55.80	53.89*	44.22*	50.40	52.84
Characteristics of Educational Process												
Support/Teaching Personnel Ratio	.12*	.14*	.13	.13	.13	.13	.15	.14	.13*	.15*	.16	.18
Years of Teaching	10.61*	12.49*	11.21	10.89	10.22	10.23	12.25	11.58	10.80	9.59	10.28	10.69
Recent Inservice Training	14.94	12.18	12.27	14.12	11.24	11.78	11.59	9.75	11.14	7.70	9.96	7.56
Belief in Schooling	6.06	5.99	5.74	5.69	5.96	5.89	5.83	5.95	5.76	5.68	5.61	5.59
Attitude to School Programs	11.15	11.33	11.76*	11.18*	10.97	10.89	10.79	10.41	10.57	10.14	10.76	10.83
School's Minority Concentration	69.99*	58.68*	58.23	61.98	61.44	58.10	57.20*	45.70*	48.58	54.11	54.49	51.37
School's Poverty Concentration	70.18	64.30	62.22	66.84	66.09	65.60	62.84*	54.99*	58.98	64.04	64.28	58.23
School's CE Concentration	61.71*	51.61*	55.46	52.10	46.79*	57.96*	42.89*	52.45*	37.64*	51.04*	53.61	51.01
School's Low-Achiever Concentration	51.22	48.45	45.78	46.80	48.23	48.27	47.49*	41.22*	43.54	46.32	45.86	43.17
School's Central Resources	.72*	.49*	.62	.60	.58	.53	.56	.50	.50	.45	.54	.46
Parent/Community Involvement	56.16	55.04	53.69	54.05	51.12*	57.60*	50.43	51.64	49.50	51.11	50.72	49.22
Principal's Instructional Leadership	56.43	56.24	55.47	54.91	54.53*	56.62*	55.44	54.83	53.73	54.22	53.97	55.23
Teacher's Involvement in Decisions	41.42	42.14	41.49	42.47	41.15	41.30	41.37	40.66	40.22	40.81	41.19	41.70
Disturbance of Instruction	58.95*	67.42*	58.33	55.56	56.41	57.93	58.48	55.83	54.89*	60.99*	60.53*	64.37*
District's Testing Program	1.00	.99	1.00	1.00	1.00	1.00	1.00	1.00	.99	1.00	1.00	1.00
District's Percent of Administrative Staff	5.49	5.68	5.01	5.22	5.12	5.06	4.79	4.95	4.64	5.05	4.80	5.18
Effort in Curriculum Development	14.27*	10.13*	14.91	15.60	13.78	13.20	13.94	15.44	13.78	13.51	13.99	15.24
Teacher's Use of Lesson Plans	.94	.94	.90	.94	.82	.78	.94	.97	.95*	.88*	.94	.96
Frequency of Feedback per Semester	126.63	129.37	130.95	120.36	130.33	130.84	135.82	136.99	131.38	116.69	118.79	114.55
Weekly Homework Assigned	.48*	.32*	.58	.62	.95	.93	.87	.76	.97*	1.23*	1.02	1.11
Monthly Use of Materials	51.14	49.37	48.53	45.57	39.43	41.76	43.34	42.10	40.16	39.48	38.19	36.58
Individualization of Instruction	17.52	17.15	17.40	16.91	17.83	18.28	17.43	17.71	17.86	18.01	18.49	18.42
Monthly Use of Audio-Visual Equipment	9.14	11.42	10.25	15.02	12.64	10.47	17.57	16.08	14.33	10.35	15.42	15.51
Extent of Ability Grouping	8.57	8.60	8.65	8.80	8.62	8.56	8.74	8.85	8.98	8.76	8.65	8.83
Class Size	20.22	20.52	20.24	19.04	20.43	21.39	21.75	21.59	20.61*	22.90*	23.54	23.49

* Means for the two groups differ significantly at the .01 level.

Note - The differences in N's between this table and Table H-8 are due to missing data for the educational variables.